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90TH ANNIVERSARY
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Biggest Earth Movers

PAGE 53



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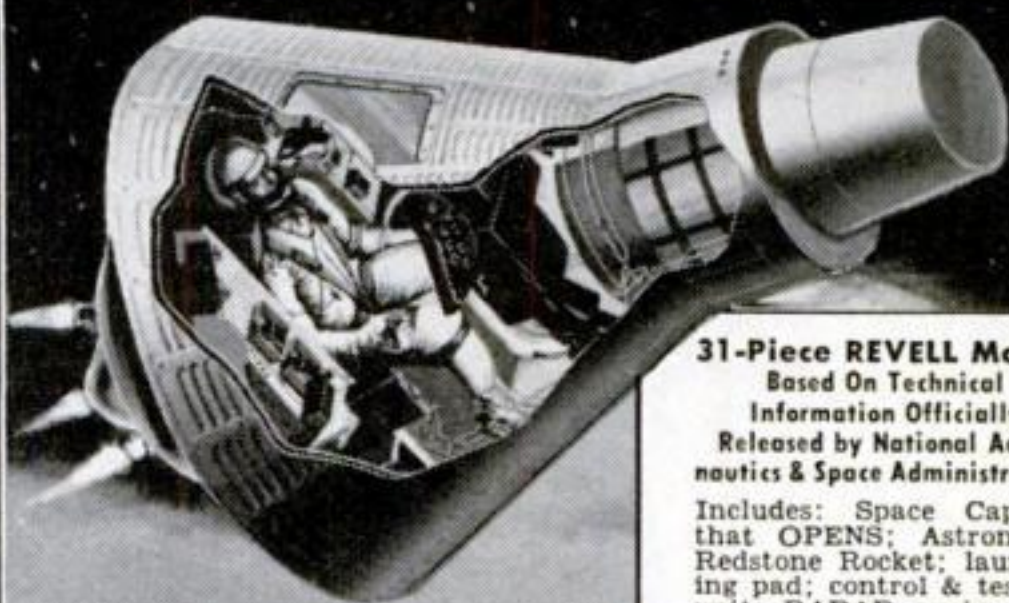
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22-SC21



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5. WHEN I SAW THE THREE FREE BOOKS, I KNEW I'D FOUND THE ANSWER. I ENROLLED —AND I WAS ON MY WAY!

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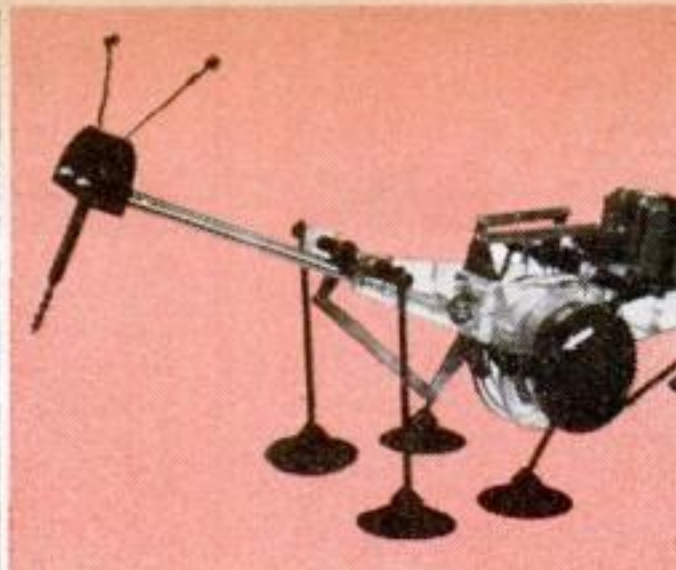
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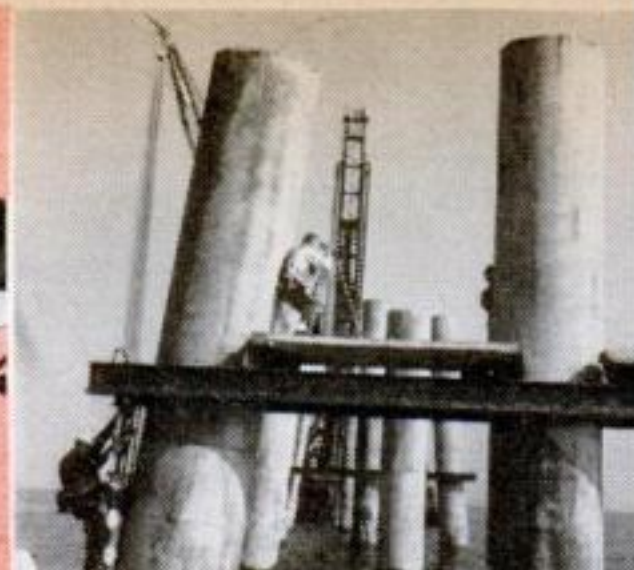
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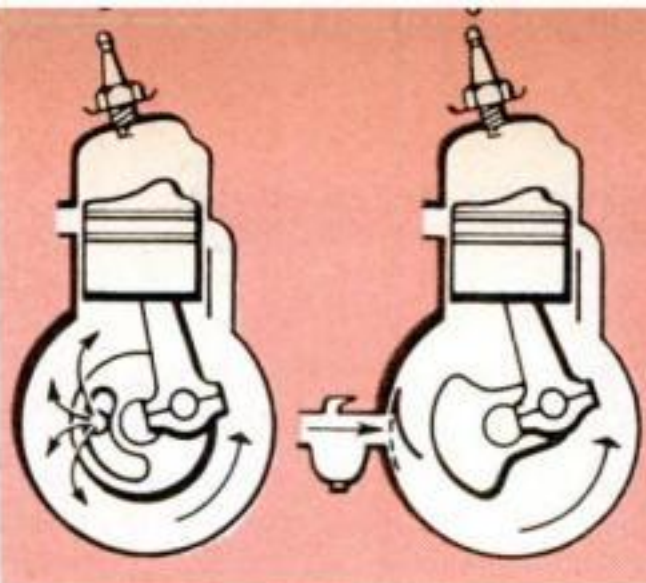
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Outboards: A far cry from the tinker-and-sweat days. *P. 110*



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90th
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PS Readers

TALK BACK



Old Coyotes Never Die

YOU speak of the coyote's "last stand" ["Coyotes Roam Hollywood Hills," Dec., p. 68]. Don't you believe it. In the words of Courtney Riley Cooper, "When the last man on earth dies, there will still be coyote."

I've brought down some of these varmints and shot at a lot more. I agree they're smart—yet in some ways they're pretty dumb. A coyote can't count. Two hunters can go into a coyote area and as long as they both stay there, they won't see coyote. Let one hunter stay there and the other leave noisily, and in a few minutes Mr. Coyote shows. Or four men can drive up a mountain in a jeep, three dropping out at different spots to take cover. The other man drives the jeep off the mountain—and the coyote appears. But not if the jeep stays.

This works okay for deer, too—only you don't have to leave with the jeep. Just leave it in the open and keep away from it. How else would a 73-year-old get his buck?

G. D. SKELTON, Beverly Hills, Calif.

... MANY residents of the Hollywood Hills, and I am one of them, would like to see Rennie McEvoy (whose gruesome "hobby" is the extermination of wild life) caught in his own coyote traps.

RON MORRISSEY, Beverly Hills, Calif.

At the Right Price

YOUR article, "Instant Fuel Meter Helps You Stretch Gas" [Nov., p. 72], notes that the device, installed, costs about \$60. I drive a Buick Roadmaster and have a fuel meter on it that didn't cost me a dime. The car came tuned for high-test gasoline and I use regular. At the first sign of a spark knock, I know I'm feeding too heavily and raise my foot very slightly on the accelerator. This system works fine and is guaranteed to improve your mileage.

M. D. WESTBURY, Orangeburg, S.C.

... I'VE always dreamed of having an instant fuel meter like the Drive Master, but my dreams went a step further. I think a

hookup to the speedometer and a simple computer (analog) should be included to give instantaneous miles per gallon, rather than gallons per hour.

LT. W. D. CLARKE III, Atwater, Calif.

Ongaro Dynamics Industries, Columbus 12, Ohio, has just such a fuel meter in the advanced stages of testing.

Takeoff of Chevy II

IN OCTOBER [p. 86] you say you clocked the Chevy II, 0-60 m.p.h., at 21.9 seconds. In January [p. 70] you say the Chevy II does 0-60 in 17 seconds. Which is right?

JOHN T. EVANS JR., Warsaw, Va.

The Chevy II reported on in October had an automatic transmission, the one in January a manual transmission.

Fallout Over Fallout

"PLAIN Facts About Fallout Shelters" [Dec., p. 56] is a valuable help toward defining what a shelter must be to provide a degree of protection. Nothing I have yet read, however, expressed the cold statistical reality the public must grasp before adequate shelters can be provided.

Many readers probably interpreted with satisfaction the 90-to-95-percent protection provided by a home basement to mean a 90-to-95-percent chance of survival. The cold fact is that in an area of heavy fallout (you specify 6,000 roentgens per hour), protection from only 95 percent of this radiation is equal to a fatal dosage in two hours. The difference between six minutes' exposure unprotected and two hours' exposure in such a sheltered area is not what I would wish to label a protection factor.

Even author Martin Mann's 99-percent protection is not adequate with a 6,000-roentgen intensity. This will permit an exposure within two weeks of approximately 300 roentgens, sufficient to cause some deaths and almost certain sickness. The difference between 99 percent and the 99.9-percent protection suggested by the OCDM could mean death or survival.

VINCENT J. COOL, Architect
Kansas State University
Manhattan, Kans.

Our arithmetic does not agree. Allowing for the decay of fallout radioactivity, a 99-percent-protection shelter might be useful if



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not really adequate. If initial fallout intensity were 6,000 roentgens per hour, the accumulated dose after two weeks in such a shelter would be less than 150 roentgens, which is likely to sicken one out of four but unlikely to kill anyone. The shelters recommended by Civil Defense aim for far better protection than that—at least 99.9-percent shielding. Under some conditions, even this would not be enough.

... CIVIL Defense specs for air filters in fallout shelters should require something more than the ability "to keep out bugs," as Mann intimated. Fallout particles would be of many sizes and they would not all settle at the same time. Winds and even breezes would tend to carry fallout particles near air intakes during their operation.

Even a damp towel in the upper end of the intake would do a reasonable filtering job. But most people who go to the trouble of purchasing a pump for their air supply would prefer a filter that would keep out objects considerably smaller than insects.

FREDERICK BRETSCHNEIDER
Chief Radiological Officer
Cambridge, Ohio.

The Government's Office of Civil Defense says no, air filters are NOT necessary for family-size fallout shelters.

... I WAS appalled by the implication that there would be much left after a nuclear war by an enemy bent on our defeat. Some of your tragic half-truths:

Minimization of 1) the extent of possible total destruction, 2) the insidious nature of radiation sickness with its often delayed killing action, 3) medical science's inability to do much for the exposed person, and 4) the nature of a community after attack.

Why assume that radio stations will broadcast radiation level? Transmitters, antennas, and power lines would be gone! Why assume availability of food after two weeks—for without electricity, our technology will grind to a halt. Fuel for most forms of transportation is pumped by electric motors; communication requires power. Will linemen be out exposing themselves to killing radiation to repair power lines? Who will rebuild power stations, and with what?

C. F. ROTHE, Ph.D., Indianapolis.

Our article made clear, we thought, that fallout shelters offer real protection mainly in areas distant from ground zero, where blast damage would be limited but fallout might be heavy. Large sections of the country might face this situation after even a heavy attack on the U.S. There, public utilities, radio stations, and stored food

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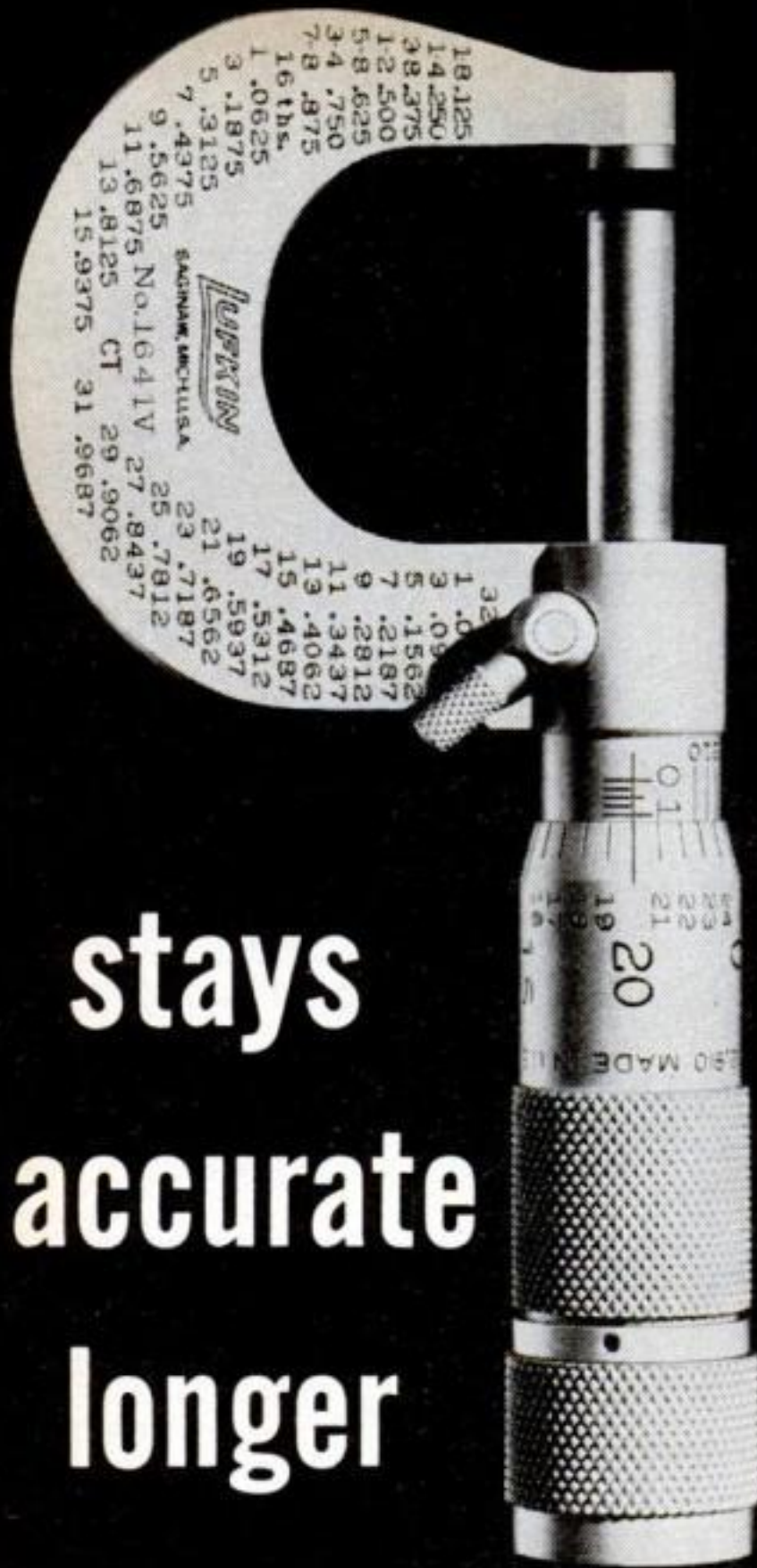
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SAGINAW, MICHIGAN

supplies would not be harmed. To maintain them, some public servants—police, civil-defense workers, military forces—would be expected to accept risks of radiation injury.

. . . It looks like the main problem of life in heavy fallout can be boiled down to thirsty-two weeks in a shelter. Where will you get enough water?

JACK WEISS, Memphis.

Best idea: Stock it in advance in unbreakable containers. However, city water—if it comes from wells and is stored in covered tanks—will be uncontaminated and, in many areas, flowing from the tap. There's also much extra fluid around your house—hot-water tank, toilet tank, ice cubes, and bottled or canned milk, soda, and juices. All this will be safe. One odd source is an electric dehumidifier: If you have power, it will squeeze potable water from the air.

Leather's Not for Burning

I HAVE a warning for anyone who makes the dryer for overshoes and rubber boots ["Wordless Workshop," Jan., p. 176]. Don't



use it to dry leather boots or shoes. Wet leather will burn before it dries and must be kept away from direct heat. The same applies to rubber-soled shoes with leather under the rubber. If the rubber sole is lifted, burned leather underneath can be crumpled in the fingers.

B. H. JOHNSON, Clackamas, Ore.

Is Evolution Reasonable?

YOUR flippant comment on evolution ["PS Readers Talk Back," Dec., p. 26] shows a lack of scientific background. The theories on atomic structure and electromagnetic wave propagation respond to all mathematical and empirical tests and stand up under any scientific approach.

Evolution—especially Darwin's variety—cannot. He assumes that magnificently intricate designs, because of similarity, must have evolved from a common source by unintelligent happenstance.

Self-adaptation to environment to increase chances of survival, to be of any value, must be complete and reproducible. To say that minute changes taking place over eons bet-

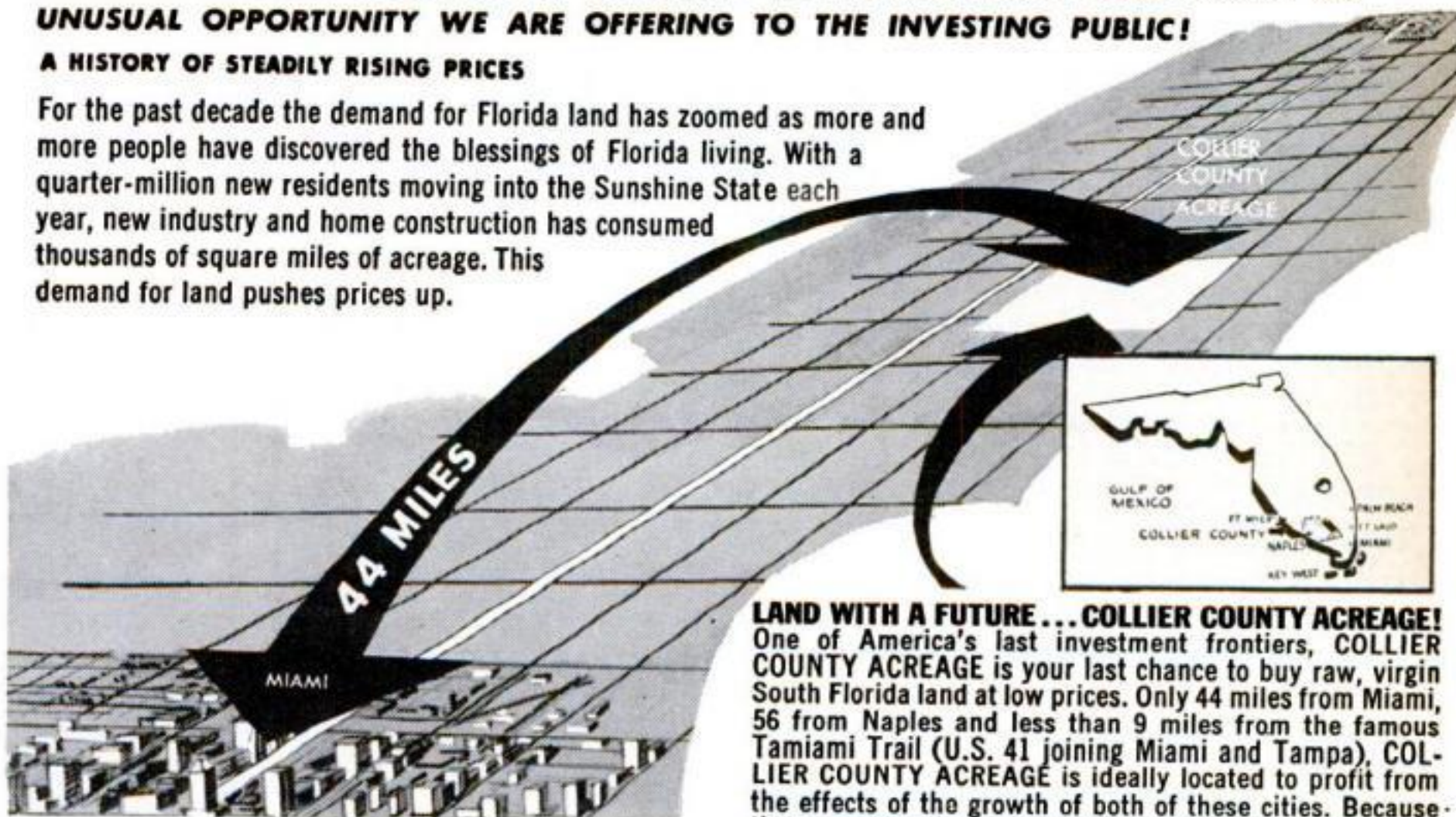
[Continued on page 14]

the Florida Land Boom is **JUST STARTING** in Collier County!

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"BETTER BUY LAND NOW, 'CAUSE THEY AIN'T MAKING ANY MORE, NOWADAYS." The immortal Will Rogers, famous for his knack for talking straightforward horse sense, made that statement years ago—and it certainly applies to Florida land today. As the demand for Florida land continues—and it will as more and more families take up residence every day—the supply of land diminishes. The inevitable result of increasing demand and diminishing supply is one that every economics textbook clearly states—prices must go up!

ANOTHER CHANCE FOR THOSE WHO SAY, "I WISH I HAD A SECOND CHANCE!" Many investors have sat on the sidelines, watching land prices zoom to beyond their reach before they decided to act. Fortunately, there is, once again, a chance for them to share in the golden future of Florida land, to make a sensible, forward-looking, speculative investment in virgin acreage at low prices. They can do it now, for a very limited time only—for as little as \$445 per 2½-acre tract—with only \$1 down and \$10 a month!

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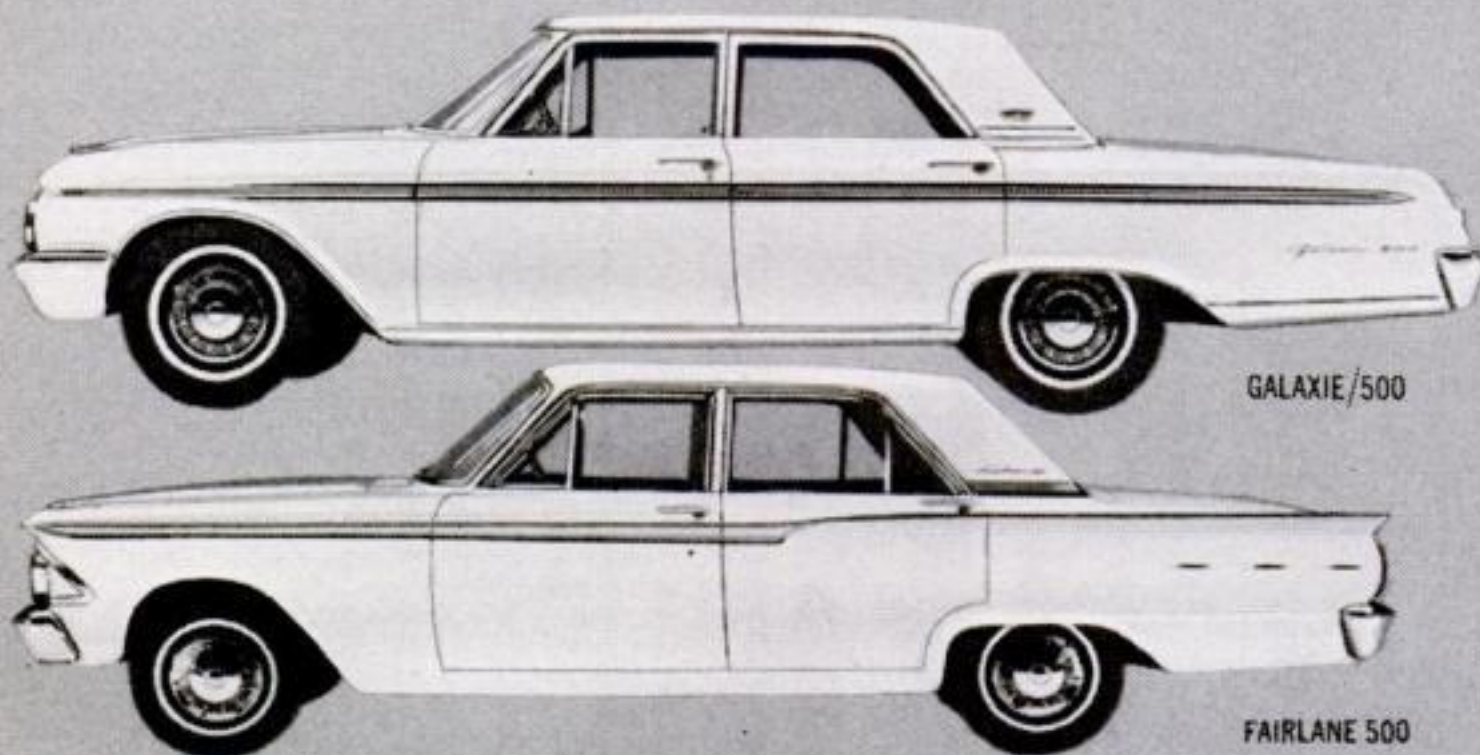
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SPECIFIED SERVICE INTERVALS FOR AMERICA'S LEADING CARS

MAKE	GALAXIE AND FAIRLANE	CAR "A"	CAR "B"	CAR "C"	CAR "D"	CAR "E"	CAR "F"	CAR "G"	CAR "H"
1,000 MILES		X	X	X				X	X
2,000 MILES		X	X	X				X	X
3,000 MILES		X	X	X				X	X
4,000 MILES		X	X	X	X	X	X	X	X
5,000 MILES		X	X	X				X	X
6,000 MILES		X	X	X				X	X
7,000 MILES		X	X	X				X	X
8,000 MILES		X	X	X	X	X	X	X	X
9,000 MILES		X	X	X				X	X
10,000 MILES		X	X	X				X	X
11,000 MILES		X	X	X				X	X
12,000 MILES		X	X	X	X	X	X	X	X

*Note: Only Ford-made cars have all maintenance scheduled at 6000 mile intervals, twice-a-year for the average motorist.



Look how close Ford has come to the “fill-it-and- forget-it” car



Only twice a year—or every 6,000 miles—does a Galaxie or Fairlane need an oil change and routine maintenance—that's all. They purr along for two years between changes of engine coolant-antifreeze and go 30,000 miles—two and a half years for the average motorist—between major lubrications. And they never need a brake adjustment!

The ideal, of course, is the “fill-it-and-forget-it” car . . . the one you never have to do anything for but buy gas. But, unless you have been paying particular attention, you may not know how close Ford has come to this ideal.

The biggest time- and money-saver is the 6,000-mile interval between oil changes and minor lubes. If you buy your Galaxie or Fairlane in the Spring the birds will fly south again before it has to go in for servicing.

Another big advance; all Galaxies and Fairlanes now come with low-cost engine coolant-antifreeze in the radiator. For two whole years—or 30,000 miles—you don't have to worry about cold snaps or engine corrosion. The 30,000-mile, more worry-free period also applies to major lubrications (compared with many cars, that saves you 23 extra chassis lubrications and \$34.50 in two years). Also, by engineering this continuous protection into your car, Ford virtually eliminates any chance of forgetfulness that might mean injury to engine or running gear. You can't overlook a 1000-mile lube because it just isn't needed!

How much this means in a sweeter running, longer lasting car we'll leave up to you. But you can't overlook the savings or safety of Ford's *automatic* brake adjustment. Every time you back up and apply the brake it adjusts any slack there may be in the clearance. During the life of the lining, you never have a “low” pedal because of improper adjustment of brake shoes to brake drums.

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[Continued from page 10]

ter chances of survival strains scientific reason. Out of hundreds of thousands of mutations studied, scientist Hermann Muller found none to have improved upon the original fruit fly or helped its chance of survival—rather, to the contrary.

To imply that evolution is as reasonable as atoms and magnetic waves is fallacious.

S. BRINKER BECK, Kingston, N.Y.

A Plastic-Age Stradivarius

JUST read about the plastic violin in kit form ["What's New," Dec., p. 94]. After experimenting for about two years, I've found that plastic wood under certain conditions makes excellent violins. I've made



three violins, a viola, and a cello of it and they all worked out as well as I had hoped. Maybe some other readers might like to experiment along these lines.

JOHN MILLAR, Concord, Mass.

The Five-Gate Boxes

I SEE I'm not the only one interested in four-speed transmissions ["What's So Good About 4-Speed Boxes?" Dec., p. 62]. I'm disappointed in the ratios offered, though. The low-powered jobs won't fit my needs (I haul a trailer) and the others are strictly high-performance hot-rod stuff.

There was an omission in the list of cars with four-speed boxes: The International Travelall is available with a V-8 or six-cylinder engine, plus an array of transmissions to make everybody happy, one of them a four-speed box with a first gear that has power for tough pulls. This may be my next car.

MARTIN HUIKKO, Litchfield, Minn.

... WHAT do you mean "low gear on three-speed transmissions is, of course, unsynchronized"? On my 1961 Volvo PV544 three-speed transmission, low speed is synchronized. And I quote the manual: "All forward speeds are synchronized."

DR. S. A. KADNER, Brooklyn.

The article concerned U.S. cars only.

... CONGRATULATIONS to Detroit for bowing to public pressure and making the four-speed box generally available. But how about

CONTINUED



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more thought on what they stick inside the gearbox casings?

Economy is obviously an important factor in manufacture, as in other car parts. But in adapting the Borg-Warner four-speed to sedans, someone took part of the joy out of the fine set of Corvette ratios. To obtain an adequate first, the mainshaft-countershaft ratio was changed. This, unfortunately, also lowers second and third. So you end up with beautifully close first, second, and third gears, and a relatively large gap from third to top. It's not so bad with Ford's set, but still annoying.

I can offer Detroit a fine set free: first—2.57:1, second—1.8:1, third—1.31:1, fourth—direct. I call this a 24-27-30 selection. First and second correspond closely to those of the old Plymouth three-speed.

As for the Corvair in particular: If they absolutely need a 3.5:1 starting gear, they might try 2.05 and 1.37.

E. F. ROCKWOOD JR., Portland, Ore.

... ONE advantage of the four-speed box you failed to mention adds to its appeal for many drivers: By shifting into high with a stick, then opening the throttle gently, it is often possible to get traction on snow. With the combination of stick shift and snow tires, you can eliminate tire chains except under extreme conditions.

MURRAY FAHNESTOCK, Pittsburgh.

... YOU say the introduction of the Buick Skylark caused Chevrolet to produce the Corvair Monza, and triggered the current "luxury compact" craze. This is incorrect.

The Monza was first produced in mid-1960 (as a '60 model). It was not until 1961 that the Skylark came out (as a '61 model). The Monza was the first luxury compact with bucket seat and four-speed-box concept. All other makers merely followed Chevy's lead.

C. W. SMITH, Jersey City, N.J.

Two-Man Skis—Two-Man Falls?

THOSE two-man skis ["New Ideas from the Inventors," Dec., p. 85] would be impractical and even dangerous. If the skis were to be at all maneuverable, the two



skiers would have to be close together (as you show them) and work together in lifting or turning the skis. The beginner certainly wouldn't know what to do, and his weight

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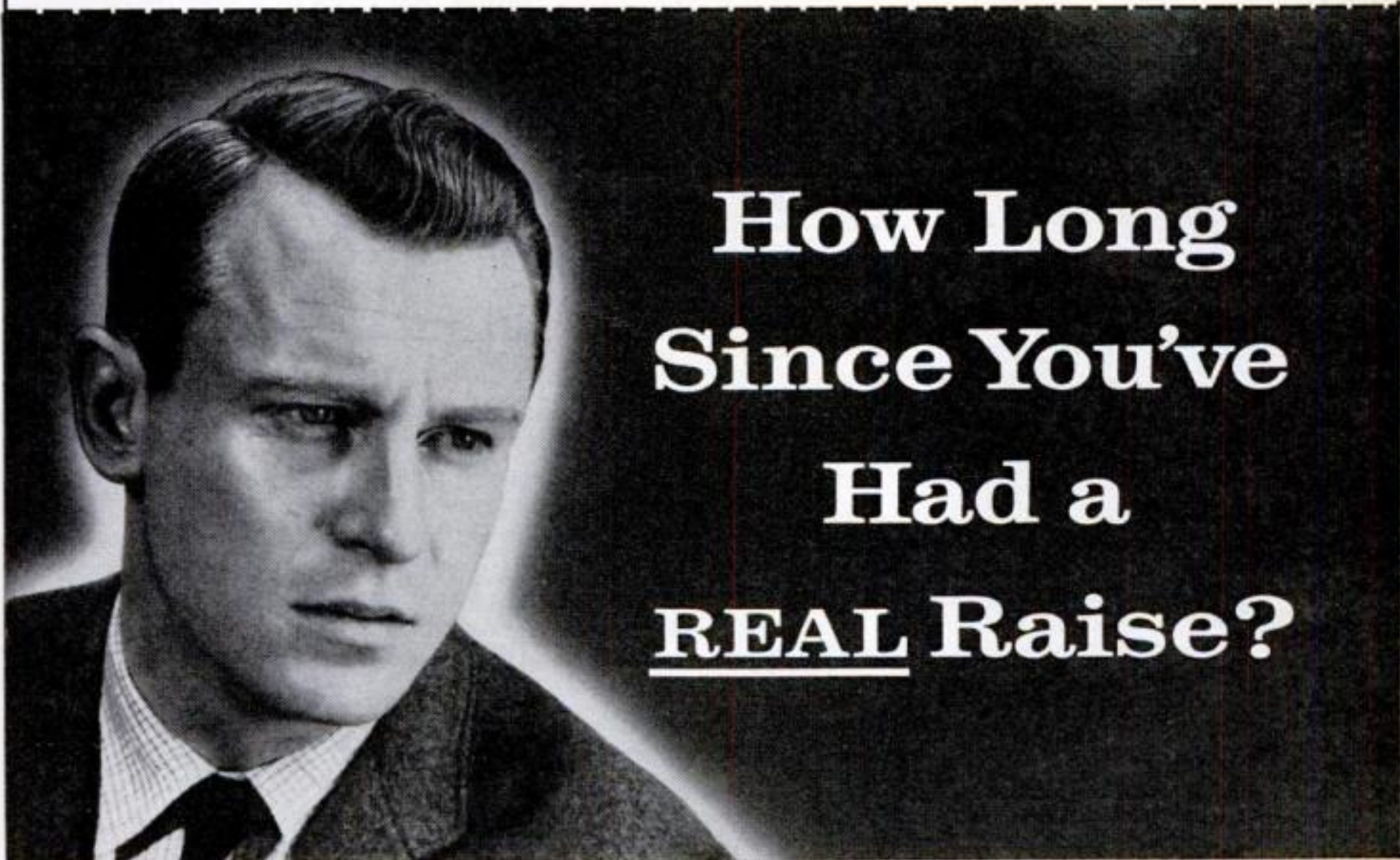
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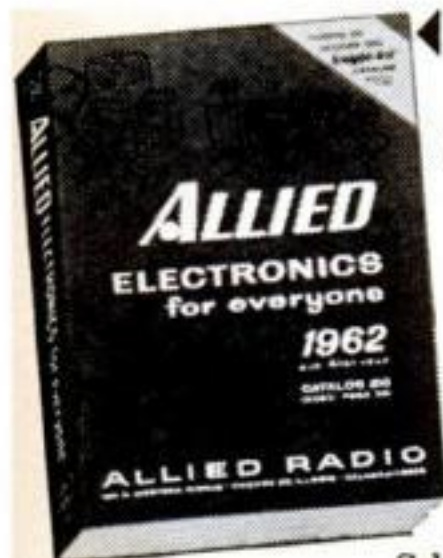
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would prevent the instructor from moving the skis. And the skis would behave so differently from single skis that the beginner might have difficulty learning to "solo." The double skis would be dangerous because a quick turn or stop would be impossible.

RICHARD HORVITZ, Cambridge, Mass.

PS Rocks the Cradle

THOUGHT you'd like to see recently arrived Alison trying out her contemporary cradle, built from PS plans [Jan. '60, p. 172]. The estimate for walnut and maple was a bit expensive, so I substituted Honduras mahogany and fir.

LEN SAWYER, Vancouver, B.C.



Weird Coincidences Pile Up

I HAVE a couple of dillies to add to the weird coincidences with car keys ["PS Readers Talk Back," Jan., p. 22].

In 1958 my brother-in-law bought a '54 Pontiac. Arrived at work, he put it in the parking lot only to find at lunchtime that it was locked in by a '56 Chevy. He tried his ignition key in the Chevy's door lock; it fit. He tried it in the ignition; it fit. He then moved the Chevy. Having taken all this trouble to get going, he sat around and waited for the Chevy owner, just to see his face. It was worth waiting for.

There's more. A few months ago, my brother-in-law drove his 1960 Ford into a parking lot. There was no space left, but my father's car was taking up two spaces. My B-in-L whipped out his own key, stuck it in the ignition of my father's '52 Ford and moved the Ford over to make room for himself. And they say lightning never strikes twice in the same place!

DONALD SUGARMAN, Meriden, Conn.

... LET me pass on what I thought was common knowledge. All automobile companies use a number system for designating keys. This code number is stamped on the original key of the car. Thus a lost key can be replaced by giving the locksmith the number. There are 9,999 numbers (the code numbers are four digits each), so every 10,000th car has the same key. The number system isn't changed from year to year; consequently there are many cars on the road with duplicate keys.

The numbers, incidentally, refer to the way the key is cut, each digit referring to one "notch" or one tumbler of the lock. A zero means no cut at all in the specified spot, while a 1 means a cut of about 1/64 inch. The locksmith is provided with a key

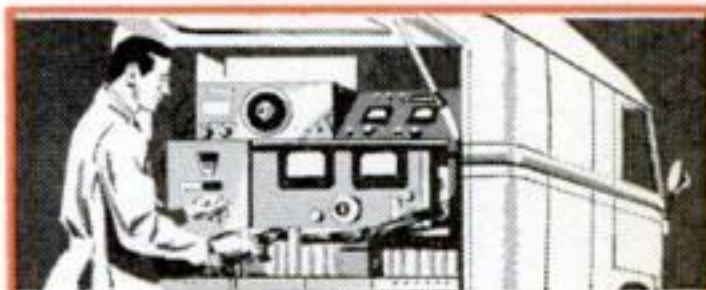
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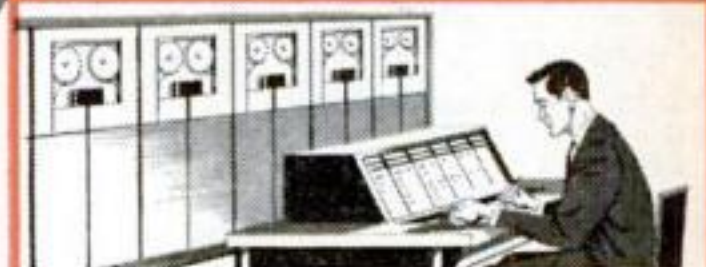
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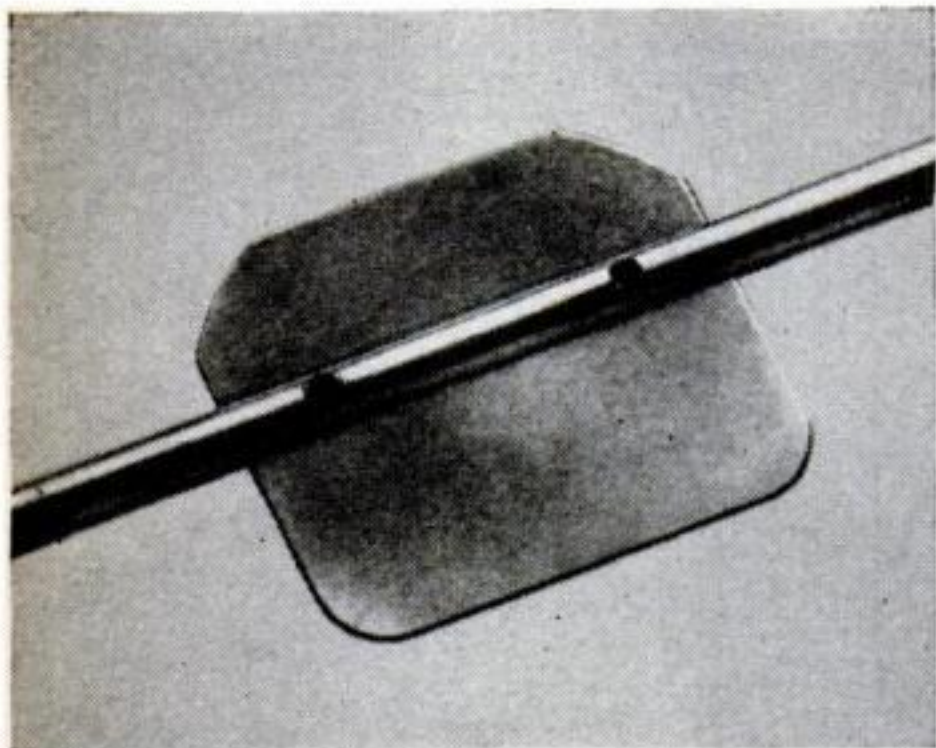
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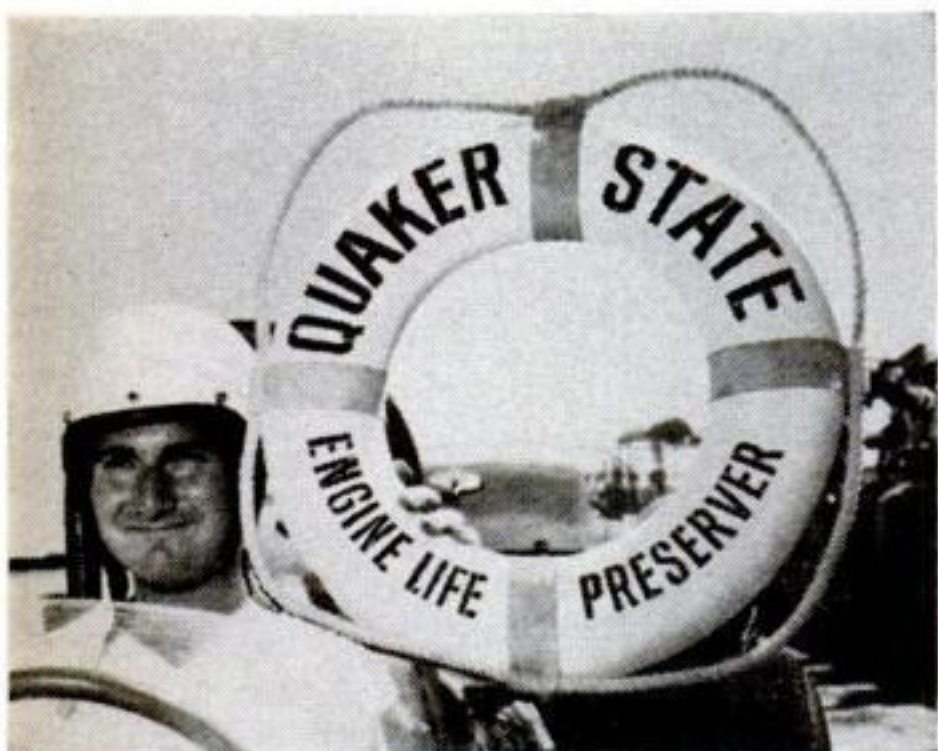
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cutter, on which he dials the number, applies pressure—and the key is cut.

It's a good idea to make a note of the code number on your car key (like scratching it on the underside of a pull-out ash tray). Then, even if you can't find your duplicate, you can easily have more made.

D. C. REYNOLDS, Haverford, Pa.

Gunk Says Bunk!

ONE of your letters [Sept., p. 10] carried a tip instructing readers how to clean their automobile engines economically.

Gunk says bunk!

The Gunk Laboratory has made extensive tests with the particular household detergent recommended by your reader, diluted with petroleum solvent, and we found that the solution was unstable and the cleaning performance relatively ineffective when compared to that attained by using genuine Gunk G.P. or Engine Brite degreasers. The tests also proved that it was necessary to use over four times more detergent and solvent mixture than is ordinarily necessary when using Gunk G.P. and that much more brushing was required in order to achieve acceptable cleaning results.

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Gunk Laboratories Inc., Chicago.

Food in Ribbons

SHAPING dehydrated pears into ribbons, sheets, and chunks ["PS Picture News," Jan., p. 101] is old hat to the people of India. When I stayed there many years ago,



I ate mangoes so preserved. I also ate sheets or ribbons of other fruits and some vegetables. Maybe the old-time Hindus were more advanced than our big-shot scientists.

B. M. BAGAI, Los Angeles.

Praise for the Gough Speaker

MY WIFE and I always wanted a hi-fi set but, because of price, we settled for a

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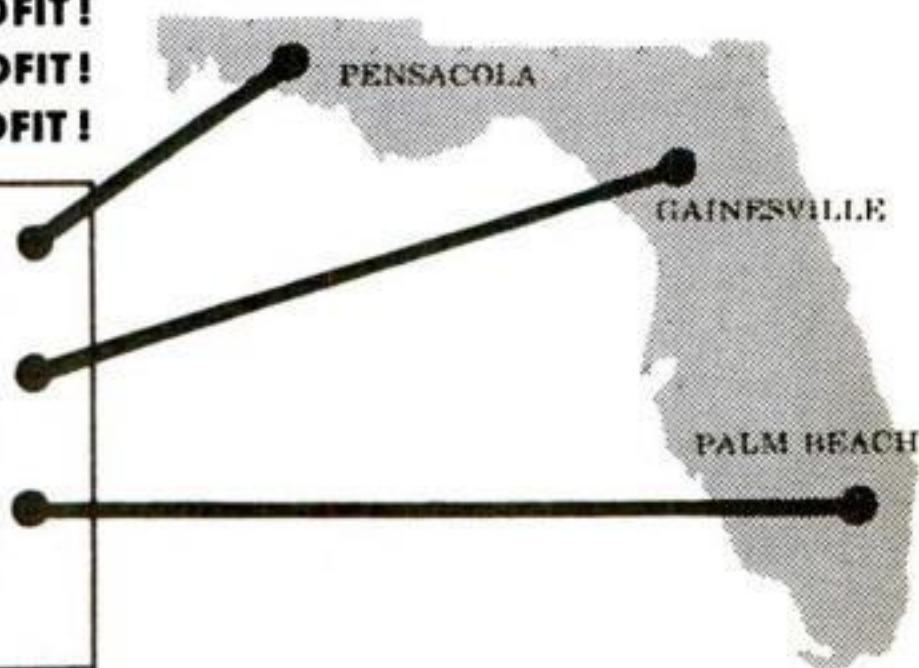
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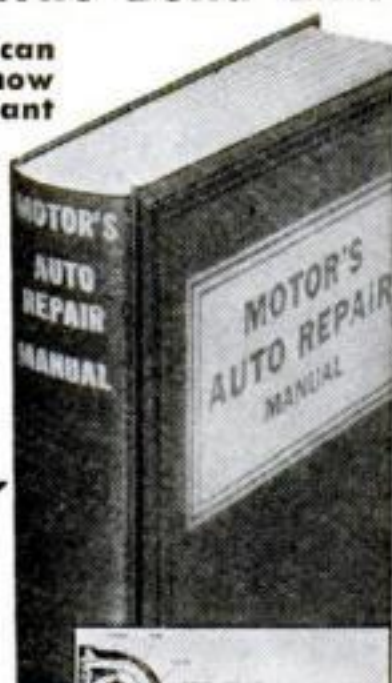
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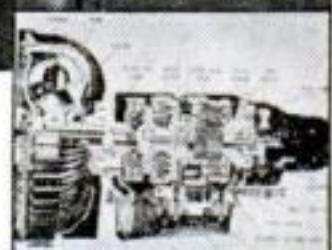
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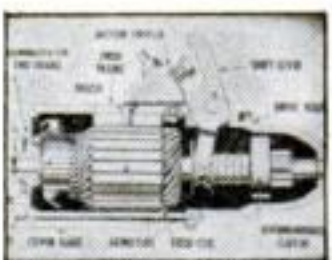
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four-speed automatic portable player. Recently at a dealer's show, we heard many hi-fi sets with those large speaker enclosures, and that did it. Our ears were spoiled for our own. Then came your article on the Gough enclosure ["Miracle Hi-Fi Speaker?" Nov., p. 168] and that made everything possible.

I built the enclosure (cost, \$13.44) and we connected one jack to our TV and the other to our player. We were in business. Do we have tone!

The only construction problem was the angle of the speaker baffle. After using a protractor on the drawing, I figured the nearest measurement was not over 19 degrees, which we used with excellent results. The bass reflex is just right in any part of the room.

We are sure grateful for the article, and heartily recommend the Gough enclosure to hi-fi fans. Our friends, including an electronics technician, are unanimous in their praise of its superb tonal qualities.

LE ROY M. DAVIS, Bartonville, Ill.

... HERE's a photo of the Gough enclosure I just finished. This was my first woodworking project and I am pleased with the results. It sounds good and I am now using it with my AM-FM radio.



ANDREW LATORRE, Farmingdale, N.Y.

Sam Colt's Equalizer

I HAVE Colt's 1935-6 Centennial Book illustrating all their guns up to that time. The gun you show ["The Story of Sam Colt's Equalizer," Dec., p. 88] is not the Peacemaker. It is the frontier, single-action .32-20 WRA and S & W Special, later also rebored to .22 cal short, long, and long-rifle target. I have a brand-new one (it won't work) and the butt side plates on it are like those on the gun you show. Those on the famous .45-cal. Peacemaker are quite different.

Incidentally, those first guns were made by blacksmiths, not gunsmiths.

J. M. NIGHSWANDER, Eugene, Ore.

Soap-Shy, Sugar-Happy Matches

I THINK I have the answer on why the hublike arrangement of matches ["PS Readers Talk Back," Jan., p. 26] reacts to soap or sugar as it does:

When soap is held at the center of the hub, it mixes with the water, reducing surface tension. With the surface tension reduced at that spot, the molecules surrounding the hub exert a stronger pull than those

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at the center. Thus the matches are pulled outward.

Why holding a sugar cube at center should cause the matches to float back again, forming "spokes" around this new hub, has me stumped. But I assume that it increases the surface tension until it is greater at center than elsewhere on the surface, and this greater force pulls the matches inward.

CAREY H. SNYDER JR., Fort Worth.

... PUT soap in water and it dissolves. The solution, having a specific gravity less than that of water, remains on the surface and moves outward carrying the matches with it.

With a sugar cube at center, the resulting solution has a greater specific gravity than water and sinks to the bottom at center. This sets up a sort of "convection current," with motion outward in the bottom and inward on top, thus moving the floating matches toward the center.

N. F. DANN, Orono, Me.

No Time for Yesterday?

I HAVE a few words for the ingenious Mr. Wieland ["PS Readers Talk Back," Jan., p. 4]. If Nasser isn't sufficiently history-conscious of his country's past to preserve the Rameses Temples at Abu Simbel, just why should we be such suckers as to spend a lot of money getting them above high water? To heck with him, I say.

ROSCOE LEEDY, Toledo, Ore.

Warming a Refrigerator

OUR small refrigerator is designed to run on either butane gas or a 12-volt car battery. Unfortunately, it is impossible to prevent it from bringing the temperature down to about 20 degrees—eggs come out as solid as



a rock. There is what appears to be an adjustable thermostat, but this has no effect even if adjusted to "warm."

Is there any way I can reduce cooling by cutting down the heat either from the electric element or the gas bottle?

W. ROPER-LINDSAY, Birmingham, Eng.

Anything you can do to cut down the heat on your refrigerator, of course, will reduce

[Continued on page 50]

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The march of science

Big-Bang up, Steady-State down. The latest round in the squabble over theories of creation of the universe has gone to the Big-Bang boys. This genteel argument has no practical importance whatever. It involves the intriguing philosophical questions that have puzzled men ever since they came down out of the trees: How big is the universe? Does it have an end—or extend infinitely? How did it start? Did it start—or has it always been?

In one corner you have burly, pun-making, Russian-American physicist George Gamow. He says the universe did have a beginning and that beginning was a very big bang. About 10 billion years ago all the atoms that now make up the uncountable stars of the sky were concentrated into one point, a superheavy glob. This glob exploded suddenly, throwing matter throughout the vastness of space.

The stars do seem to be rushing apart, as though blasted by an explosion long ago at some unknown center of the universe. Their light waves are stretched out to longer wavelengths, making the color redder than light waves originating on earth. This "red shift" indicates that the stars are moving away from us (and from each other) very fast.

In the other corner you have piano-playing, novel-writing, baggy-tweed English astronomer Fred Hoyle. His side says that there was no instant creation. The universe is in a steady state. Hydrogen atoms—the simplest form of ordinary matter—are always being generated throughout space. They always were and always will be.

If ordinary matter—positively charged protons and negatively charged electrons—is being created in space, then its mirror image—antimatter, with negative protons and positive electrons—must be created as well. When matter meets antimatter, each annihilates the other. It's like a superatomic explosion, the masses being converted into a flash of pure energy (a gamma ray).

This annihilation reaction gives a handle for testing the Steady-State Theory. You look for the gamma rays. That job was assigned to the satellite Explorer XI, sent up last year. The first report from the orbiting gamma-ray telescope is now in, and it is negative. There seem to be far fewer gamma rays than would be expected if the Steady-State Theory of creation is right.

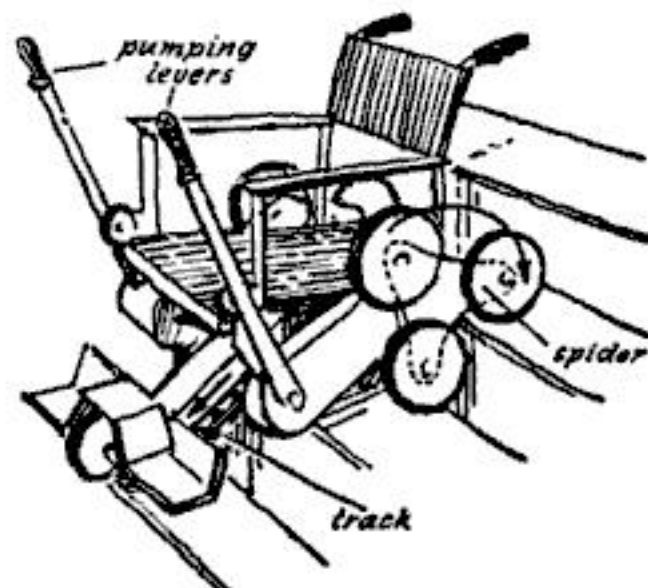
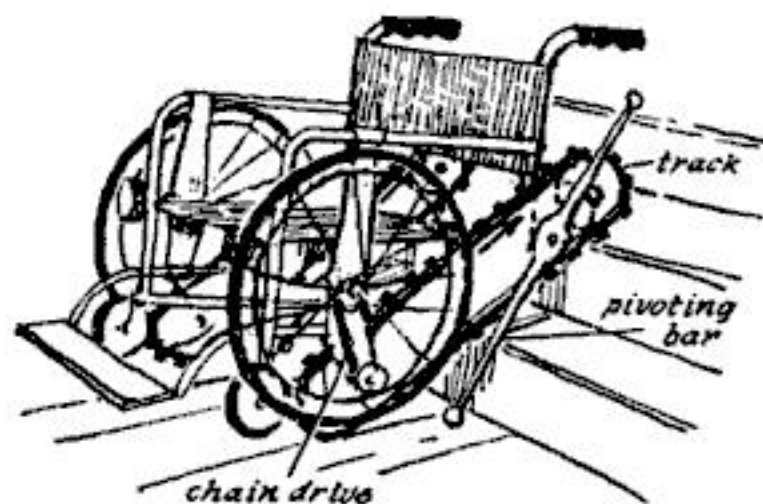
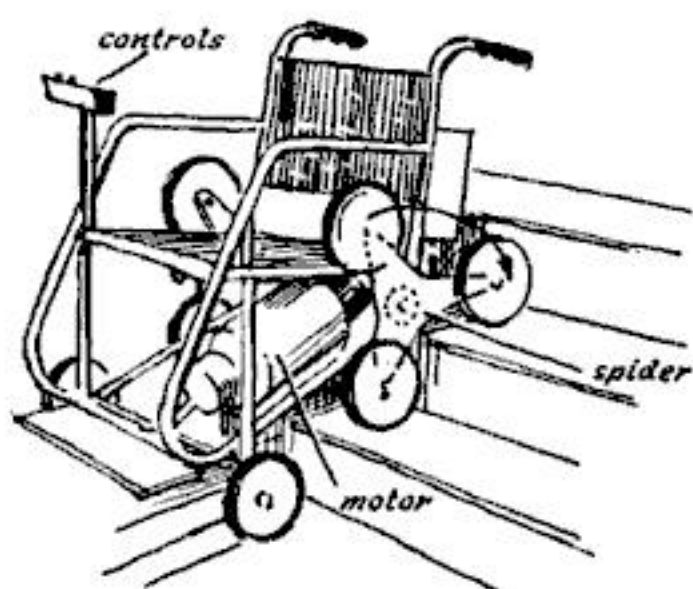
Inventors' challenge: the stair-climbing wheel chair. A lot of crippled people could quit basket-weaving for real work if they only had some way of transporting themselves to everyday jobs. In a wheel chair, a curb is very difficult and stairs impossible. So two years ago the President's Committee on Employment of the Physically Handicapped and the National Inventors Council—both agencies of the Federal Government—teamed up to offer a \$5,000 prize for a wheel chair that could climb steps. (The prize money came from an anonymous private citizen who is himself neither crippled nor interested in the wheel-chair business

but simply charitable. Commercial royalties on a successful design should sweeten the pot for the inventor.)

This plum attracted 500 entries, none of them quite good enough. Now the competition is being renewed.

The requirements stipulated by the Inventors Council are simple. The machine must be able to climb standard stairs while otherwise remaining an ordinary wheel chair: light, foldable (for carrying in cars), doorway-narrow (25 inches), sharp-turning, fail-safe, self-contained (no special ramps or outside power connections)—and inexpensive. The maximum retail cost is set at \$500, about three times the going price for present wheel chairs.

These specifications must be tougher than they look, since 500 inventors failed the first go-round. Three entrants came pretty close with ingenious contraptions. They were given \$1,000 consolation prizes (by the same anonymous donor). Their designs are shown below:



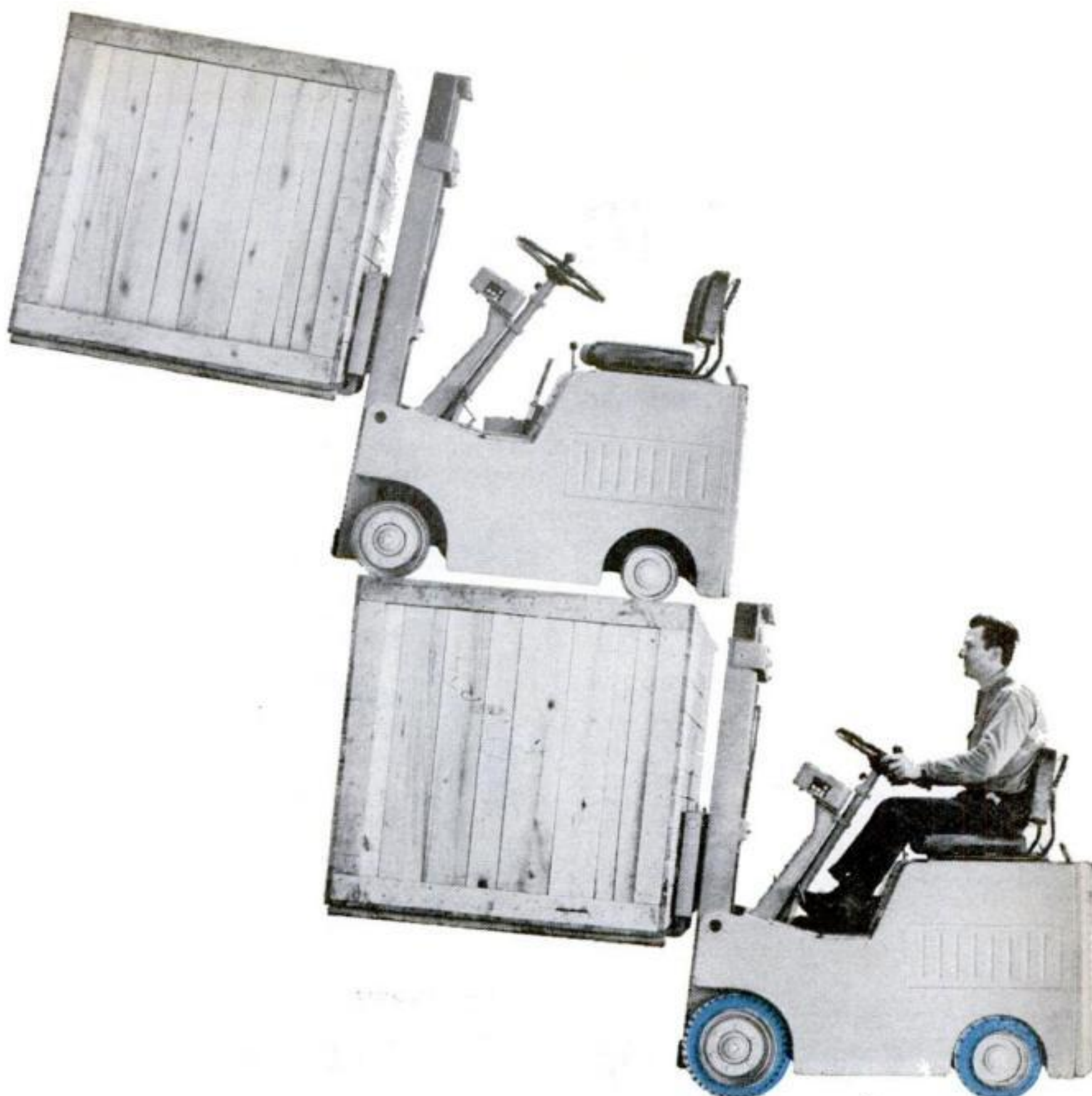
◀ Carl A. King of Lexington, Ky., proposed a rear axle fitted with a pair of spiders, each tip of each spider carrying a wheel. For level running, each spider locks to keep one wheel on the ground, and a planetary drives that wheel. For stair-climbing, the planetary shifts to rotate the spiders, which "walk" the chair up or down steps.

◀ Lionel Freeman of Los Angeles adapted the stair-climbing hand truck that refrigerator deliverymen use. His chair has a caterpillar track in the back so that it crawls over steps. A pivoted "stabilizer" bar tilts the chair from rolling to climbing position.

◀ R. B. McLaughlin used both types of traction: rear-axle spiders plus a caterpillar track, all driven by pumping on levers.

If you have a better idea, send the design to: National Inventors Council, U.S. Department of Commerce, Washington 25, D.C. (The patent problem is your problem, not the

Government's—protect yourself.) The competition runs until the end of this year, but will be renewed if the \$5,000 prize is not won.



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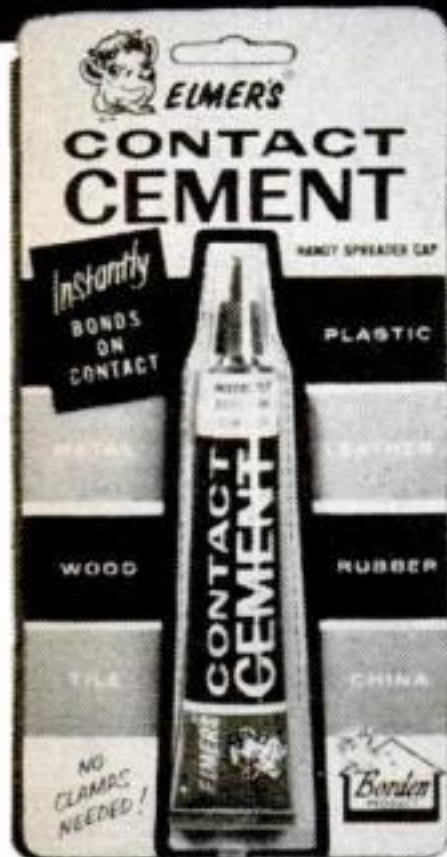
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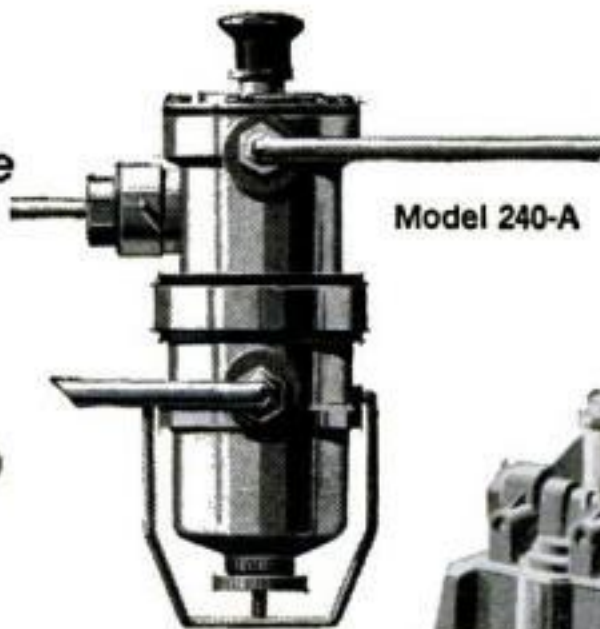
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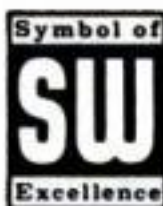
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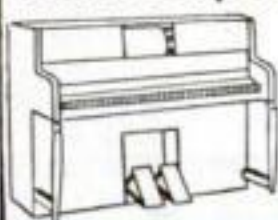
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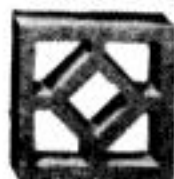
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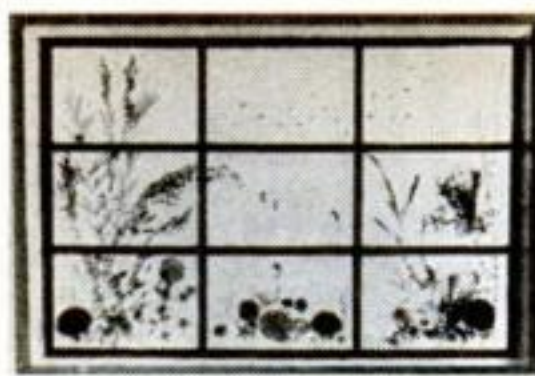
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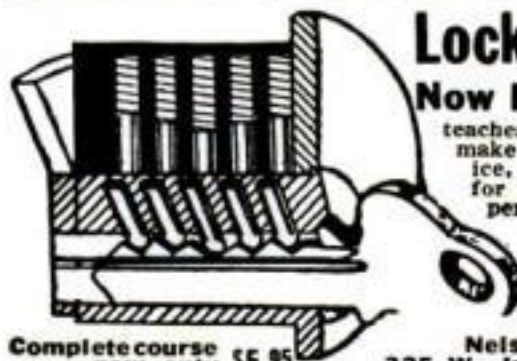
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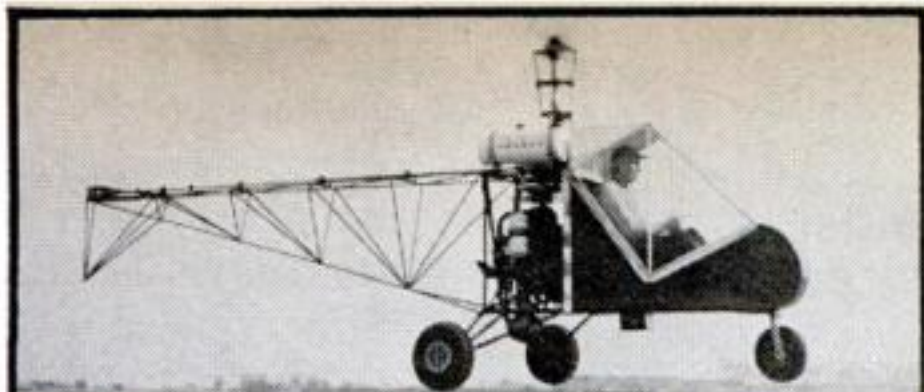
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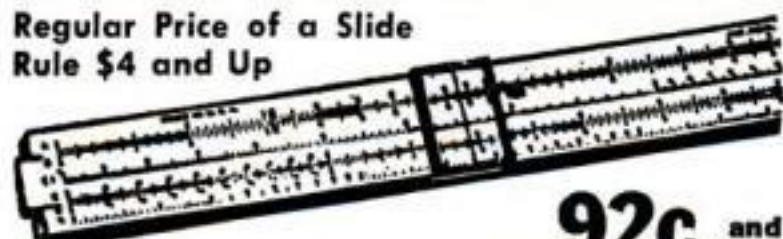
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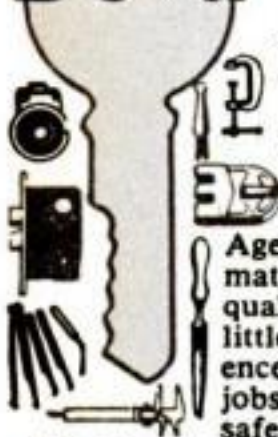
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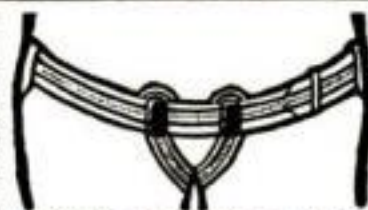
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GM Expecting Two "Little Ones"

THERE is growing interest in Detroit about the coming junior compacts, with particular attention focused on possible General Motors cars to compete with Ford's Cardinal.

The GM entries are currently called "Fisher" and "Corvair II." The Fisher reportedly is a front-engine, rear-drive car; the Corvair II is a rear-engine vehicle, like Corvair I. Ford's Cardinal—

due next summer—is expected to have front-wheel drive.

Fisher and Corvair II are supposedly still largely on the drawing board, although GM has such large internal tooling facilities that it could do practically all the tooling without tipping its hand.

Several GM officials have publicly scoffed at junior compacts, but apparently GM feels compelled to prepare a competitor for the Cardinal, if for no other reason than that Ford Motor Co. has been quite successful of late in reading what the public wants through its intensive market research. GM does only about a quarter as much market research as Ford, even though GM sells almost twice as many cars.

Extravaganza on wheels. The Big Three are deep in the planning stages of their exhibits for the 1964 World's Fair in New York. Although details have not been announced, they'll probably be the

most grandiose automotive displays ever seen. Already budgeted for these exhibits are \$58 million by General Motors, \$45 million by Ford Motor Co., and \$9 million by Chrysler Corp.

"Flight 600 calling." AC Spark Plug, GM's electronics division, is preparing for a service commercial airlines will offer generally in a couple of years—the use of a telephone while the plane is aloft.

For a fee, a passenger will be able to use a two-way radio telephone attached to one of the plane's bulkheads to phone ahead for appointments, hotel reservations, transportation from the airport, or just to report his late arrival.

Diesels go on a diet. Look for new diesel engines on the market soon, hundreds of pounds lighter than current models. Cummins Engine Co. of Columbus, Ind., the nation's leading producer of diesels, will introduce a new line in

the next few months. The weight savings are being made by switching from straight 6- and 8-cylinder plants to V-6s and V-8s, by using thinner engine walls, and by generally updating engine design. Ford's 221-inch engine showed the way.

More V-6 engines? Detroit engineers are looking forward to more V-6s, à la Buick Special, in the next year or two, but they predict the new engines will be "flatter" than Buick's which has banks of cylinders 90 degrees apart. The engineers say that the extra vibration and

roughness, characteristic of the V-6, can be reduced by increasing the angle between the banks of cylinders to about 120 degrees. If the angle is increased much more than that, they become "pancake" engines, like the Corvair's. If it's decreased, the engine becomes too high.

Too much torque. Ford engineers were slightly embarrassed by the powerful new 405-hp. engine they recently developed for use in the Galaxie.

It produces so much torque that the Lincoln Twin Range Turbo Drive trans-

mission was the only Ford transmission that could handle it. But that transmission wouldn't fit under the Galaxie's floor pan. Consequently, the 405 engine is available only with the four-speed Borg-Warner transmission.



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cooling. A series dropping resistor would work for the electric element; you'd have to rework the burner nozzle for butane.

Tips on Tips

HANGING your portable drill on dowels bolted to a board ["Short Cuts and Tips," Nov., p. 163] is easy on the drill, but under vibration the tool could "walk" and fall. I have a better storage rack:

Hunt up a large screw-eye and beat it on the anvil until the chuck just slides through it. Screw this to the wall in a horizontal position. Now you've got a rack that's sure-holding, not hard on a drill or dangerous, and unbeatable for ease of use when inserting or removing the tool. It also provides a place to coil the cord neatly.

A. C. CRAFT, Santa Ana, Calif.

... YOUR "Tips for Draftsmen" [Dec., p. 158] were interesting. Raising the triangle above the surface of the drawing is a good idea, but layers of drafting tape at the angles may be easier to apply and remove than blobs of household cement.

DENNIS M. TROUP, Huntington, N.Y.

Looking Backward

YOUR recent issues celebrating your 90th anniversary reminded me that I was also a reader when you were 75. Checking back, I was intrigued by the 75th Anniversary [May, 1947] issue. It showed old covers, one for June, 1937, featuring a car on rails to launch aircraft. What was the aircraft being launched?

A. T. CARPENTER, Vancouver, B.C.

That's a Boeing Stratoliner, also known as the 307, then only in the mockup stage. First of the four-engine commercial transports, it began its flying career in 1939. Only five were sold to airlines. At the start of World War II, the Air Corps took them over, designating them C-75s. In 1952 the five were bought by a French airline, and at last report were still in service.

The Cat-Eyed M-60

I HAVE the answer for Steve Satchell, who asks about night vision in the M-60 tank ["PS Readers Talk Back," Dec., p. 16]. The M-60 is equipped with infrared periscope for the driver. Infrared binoculars for the tank commander and an infrared periscope for the gunner are now being

tested. A xenon searchlight is also to be used to give considerable range to these night-vision devices.

MAJ. R. B. GREEN, Fort Knox, Ky.

Self-Starting for B-R-R-R Weather

EXHAUST fumes from a self-starting car that would start itself up in the garage ["Detroit Report," Nov., p. 58] shouldn't worry engineers. If they're going to depend on an automatic choke, I doubt that there'd be any fumes—or any starting. If there is a car with a reliable automatic choke, I'll appreciate knowing what it is.

I'll take the hand-operated choke and throttle controls on the dash. Then I'll get going while my neighbor kills his battery. Designers are slap-happy with automatics.

L. N. BENNER, Brunswick, Me.

... I DON'T think much of that self-starting car operated by a time clock. I have seen the same idea tried out in Alaska, only it was operated by a thermostat. This worked all right, but if the engine failed to start at once, you found yourself with a dead battery. I spent nine years in Alaska, and I found the best thing to keep a motor warm is a head-bolt heater, which everyone used. They are inexpensive. I had an Olds 98 that would start on the second or third crank in 40- to 60-below weather and it was stored in the open—as are 90 percent of all cars around Fairbanks.

LESLIE L. JONES, Seattle.

Shaving Minutes Safely

YOUR book digest, "How to Gain an Extra Hour Every Day" [Jan., p. 117], plants a dangerous booby trap for an unwary time saver. In the paragraph "Vertical is faster than horizontal," you say of newspaperman Earl Wilson that *he* says he saves five minutes a day by shaving and showering simultaneously. Now I say you'd better warn your readers not to try this with an electric razor or they'll end up horizontal for a long time!

JOHN PATTON, Clinton, Wash.

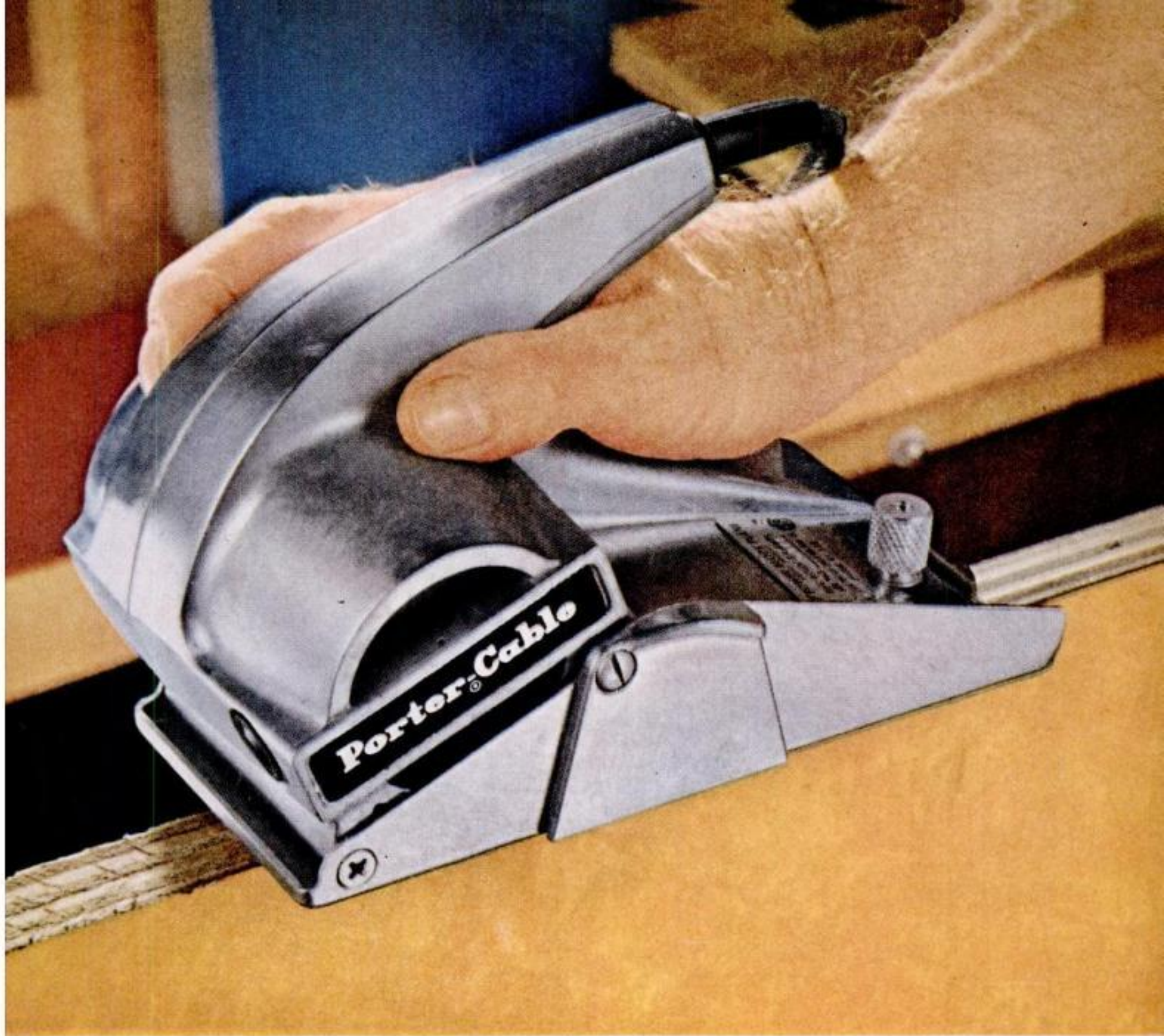
Keep It Clean!

I LIKED "Getting Full Value from a Radial-Arm Saw" [Nov., p. 156] and was intrigued with the suggestion to mount an emery wheel in place of the saw blade, converting it to a tool grinder. But one thing worries me: With sawdust and other fine material usually associated with sawing, what about sparks from the emery wheel starting a fire? If safe, the conversion is a neat idea.

B. J. KLOTZ, Vibank, Sask.

No fire where there isn't any sawdust or other inflammable material.





NOTHING ELSE LIKE IT!*

Porter-Cable Power Block Plane

You can plane any surface . . . any edge . . . make bevel and rabbet cuts . . . do *dozens* of useful jobs with this new Model 167 Power Block Plane. It's a real problem solver—and it's the only one of its kind on the market.

Compact, lightweight, it fits in the palm of your hand easily. Truly a precision tool, it is built to last. A heavy duty motor and positive belt drive transmit 21,000 rpm to the big capacity steel and carbide spiral cutter at the flick of a finger.

See this amazing tool in action at your

*(But the idea is too good to stay exclusive)

Porter-Cable dealer's today! He's under TOOLS, ELECTRIC in the Yellow Pages.

FREE FOLDER illustrates many outstanding features of the Model 167 Power Block Plane, write: Porter-Cable Machine Company, Subsidiary of Rockwell Manufacturing Company, 504C N. Lexington Ave., Pittsburgh 8, Pa. In Canada: Porter-Cable, Ltd., Box 817, Kingston, Ontario.



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MADE BY KAYOT, INC.,
MANKATO, MINN.
world's leading builders of pontoon boats



VISIT YOUR EVINRUDE DEALER'S FUN AFLOAT SHOW

1,023 PRIZES!

3 SHOWBOATS
(as illustrated)

powered by Evinrude
40 hp Lark motors.

PLUS
1,020 OTHER PRIZES

to be given away in
Evinrude's national
SHOWBOAT CONTEST!

2,100 ADDITIONAL PRIZES

to be given away by
Evinrude dealers across
the U.S. as door prizes
during their
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to be announced locally!

Win this EVINRUDE SHOWBOAT — featured at the New York boat show. It's a practical pontoon boat by Kayot, Inc. — powered by a 40 hp Evinrude Lark IV with PUSH-BUTTON electric gearshift . . . as easy to operate as your own car. There's a built-in grill big enough to cook steaks for a boatload of guests. The paddlewheels turn as you move. It's a gay sight to see and practical for day cruising and partying. Three Showboats, plus 1,020 other prizes will be given away in Evinrude's Showboat Contest!

Many Evinrude dealers will hold a FUN AFLOAT SHOW during this contest . . . between now and April 15th. Look for his local announcement. Visit his Fun Afloat Show . . . the whole family will enjoy it . . . and you'll get ideas to help you become a winner!

Get your Official Contest Entry Form and FREE Evinrude FUN GUIDE at your nearest Evinrude dealer now. Look for his name in the Yellow Pages under Outboard Motors. Evinrude Motors, Milwaukee 16, Wisconsin, *A Division of Outboard Marine Corp.*

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70 American Thermos
Giant "Pop-Tents"

100 Bolex 8 mm
Movie Cameras



100 Westinghouse 3-band
Transistor Radios



250 AMF-Voit
Water Ski
Sets



250 Turner
Camping
Ensembles



250 South Bend
Fishing Outfits

Biggest Earth Movers Tote 75-Ton Loads

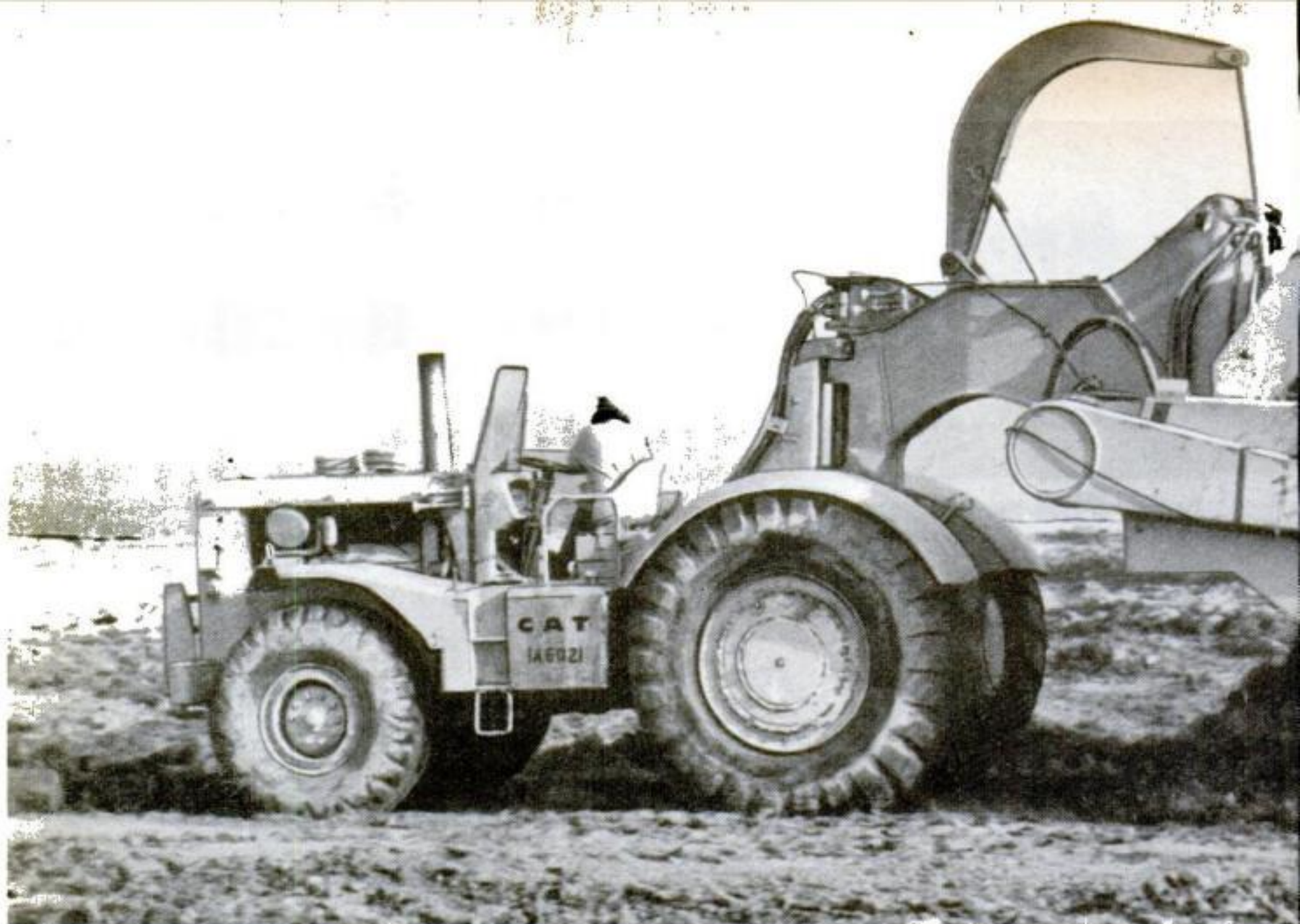
By Henry B. Comstock

TEN bellowing monsters will tear apart and reassemble a large slab of the Illinois River Valley come spring thaw. They won't be shaping a road, dam, or airstrip. They'll be gutting Caterpillar Tractor's 1,600-acre Peoria proving ground, in an earth-moving

CONTINUED

"THINK IT OVER before you buy her for a second car," Cat engineer John Lindquist tells me. "On a rough road you could burn off 20 bucks worth of rubber in an hour with this rig."





World's biggest scraper, the Cat 666 uses a 560-hp. diesel in front and a 420-hp. job in the

"spectacular" running on into summer.

Contractors who move mountains will like the show. First, because the machines are new tractor scrapers—high-capacity outfits that do triple duty as shovels, haul trucks, and spreaders. Second, these latest models are beefier, brisker, and more fully automated than before. Third, they come in as wide a range of supersizes as a nest of Chinese bowls.

For the man who bids on the 150-million-cubic-yard dam soon to be built across the Indus River in Pakistan, there's the new Cat 666. This world's biggest scraper tips the beam at 59 tons without load. She stretches 65 feet from her four-wheel tractor unit to the push block at her tail. Two diesel engines—one up front, the other aft—pour 980 collective horsepower into her four traction wheels. Mounted on the larger pair are a couple of 30-ply tubeless tires 10 feet in diameter. The tab for one of these 37½-by-51 shoes is \$8,500.

Between the traction wheels hangs a scooplike belly, or bowl, as large as a living room. Tilt its forward end down

and it becomes a shovel, lapping up enough dirt in a single pass to lower a 10-by-195-foot driveway nine inches. Then flip the bowl to horizontal and drop a steel apron over the front. Now you have a 54-yard truck that can wind up to 42 miles an hour on a good haul road. At the dump site, shove the rear of the bowl, or ejector, forward. Out plumps the load, smoothly, and to any desired depth.

Testing conditions: ideally bad. Recently, Caterpillar officials let *POPULAR SCIENCE* preview the 666 and her sisters.

"The best place to start," Chief Engineer Norman Risk told me, "is Dillon, Colorado. There, we've just placed what you might call the 'compact' model of our superscrapers in the hands of a construction outfit building a mile-long earth-fill dam. Field testing is our final step in developing a new machine. Bugs aren't likely to get by the proving ground. But if one does, you can bet a contractor will uncover it. After you've watched the 641 at work, then come back to Peoria."

So I hopped a jet to Denver and



rear. Together, they pour on 980 horsepower to keep her weight (268,000 pounds loaded) rolling.

drove to a Caterpillar field office high on the west slope of 12,000-foot Loveland Pass. There, John Lindquist, the research engineer on this project, and Dave Ottoman, Cat Colorado dealer's-service representative, took me in tow.

"Compared with some earth-moving jobs," Lindquist said, "this Dillon deal is a sandbox operation. But you couldn't find a nicer spot for field testing. The

Blue River Valley is a natural wind tunnel. When it isn't funneling in icy rain, it's whipping snow around. On clear days, it only kicks up tons of dust."

"Also," Ottoman added, "the air at 9,000 feet is skimpy enough to try any engine. The 641 is doing first-rate. Like other models, she has a turbocharger, driven by exhaust gases. It rams air into the intake manifold at just the right

EQUALLY POWERFUL MODEL 657 has the same two engines as the 666 but a somewhat smaller bowl capacity. It also uses a two-wheel tractor

rather than a four-wheeler. Contractors generally prefer to use the two-wheelers on jobs where the terrain is exceptionally rough.





A tractor scraper is three earth movers in one

1. A POWER SHOVEL: With the lip of her bowl angled down into the dirt, the Cat 641 lunges ahead, picking up 38 cubic yards of dirt. She doesn't need both those pusher dozers in tandem behind—but their 770 horsepower saves 20 seconds in loading time. When the bowl is full, powerful hydraulic rams tilt it back to horizontal, and the 641 becomes a . . .

pressure for any engine load. Because the stuff gets hot and thin in the process, it's also given a whirl through a water-cooled coil, or 'aftercooler.'"

Close scrape at 12,000 feet. "Dave's our best authority on the 641's behavior at high altitudes," Lindquist said. "To get her from the railhead at Denver to the site, he drove her over the same route you just took."

I thought of Loveland's topmost mile—a succession of hairpin turns offering an unfenced view of timber line a thousand feet straight down. It was hard to imagine anyone wheeling a 43-ton earth mover around those curves. But Ottoman brushed it off. "My only bad moment was when I belted into one bend and just squeaked by a house trailer with a swimming pool on top."

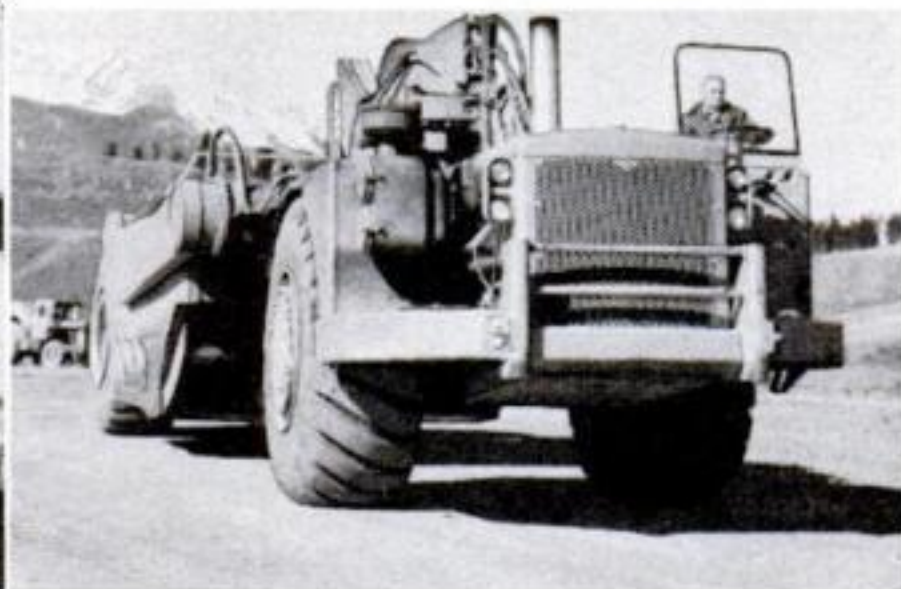
At the Blue River Valley, a huge ribbon of earth stretched as true as a mason's level between two snow-dusted mountains. Antlike outfits kept scurrying across it, voiding their loads, and hustling back. One fleet of 40-yard bottom-dump trucks was shuttling between the dam and a couple of drag-line cranes. It took three bucketfuls to crown each truck. Meanwhile, as many as eight others stacked up behind it.

"That's the soft spot in this operation," Lindquist said. "With tractor scrapers, it's different. Because they don't have to be spoon-fed, there's not a second lost in cycling time."

Bulldozers offer an assist. I soon saw what he meant. We threaded a maze of haul roads to another loading site. Here, in a muddy basin, three Cat D9 dozers



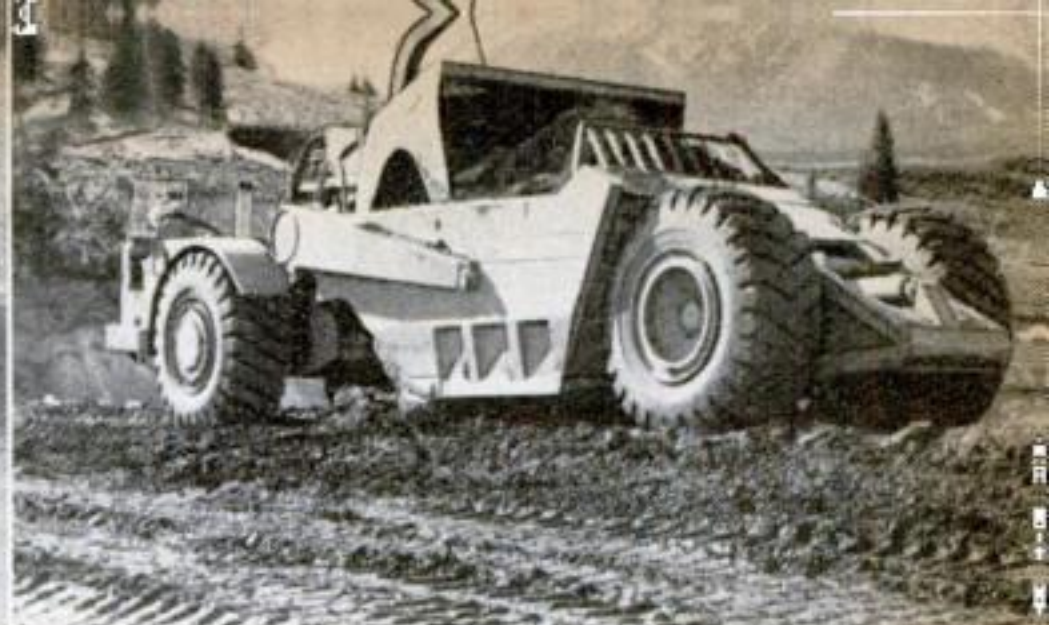
I FELT LIKE SABU, the elephant boy, when I took off down the haul road with the 641. It was out of my line to drive a rig where the radiator fan alone can soak up 25 horsepower.



FOR ALL HER 43 TONS, this huge scraper behaves like a hot rod. Tying her down was easy, too; she even has a hydraulic retarder that spares the service brakes on steep downgrades.



2. HAUL TRUCK: Pulling away from her pushers, the big machine takes off for the dump site. Most contractors build themselves first-class haul roads, both to cut cycling time and to increase equipment life. On this Potashnick Construction job at Dillon, Colo., the 641 gets up to an astonishing 40 m.p.h. Then, at the end of the dump run, she turns into a . . .



3. SPREADER: Up goes the apron, and the back wall of the bowl, called the ejector, slides slowly forward, spilling the load over the lip smoothly and without voids. On all these super-scrapers there's a conspicuous absence of out-board rigging. Only the draft arms need be removed to reduce width to an acceptable 10 feet for transport on rails or highways.

were helping out. Every two minutes a scraper came bobbing in from the dam, cocked its head for a turnaround, and plunged into the "borrow" pit. Instantly, a dozer buckled onto its bustle. Then, with the scraper's bowl angled into the dirt, both outfits surged forward, the D9 laboring like a pusher engine getting a heavy freight train out of town.

In 30 seconds, black earth was boiling over the top of the bowl. Thundering hoarsely, the scraper broke away, wallowed out of the pit, and took off for the dam.

Meanwhile the other D9s were backing rapidly into place to give the next outfit an assist.

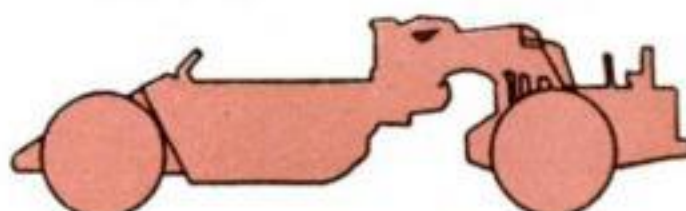
We watched three scrapers cycle through. Nobody was calling signals. But every operator was in the right place at the right time. As proof of it, two D9s were maneuvering into position for a superthrust when Lindquist pointed down the haul road. "Here comes the 641."

The canary-yellow outfit hot-rodding toward us dwarfed the rigs around her. Her driver sat in an elephant-boy position ahead of her left fender, prodding the big V-8 beside him with a heavy foot. I remembered the specs: "Horsepower, 560 at 2,100 r.p.m.; 5.4 bore by 6.5 stroke; bowl capacity, 38 yards." *Some compact*, I thought.

Sitting high. Ottoman was out on the road, waving a washout signal. When the scraper belched to a stop beside us,

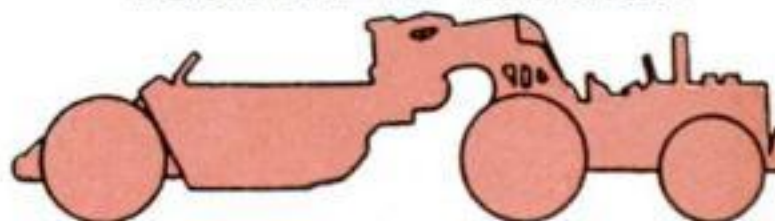
[Continued on page 208]

TWO-WHEEL TRACTOR



MODEL	CAPACITY	ENGINE	HP.
651	44 cu. yd.	V-8	560
641	38 cu. yd.	V-8	560
631B	30 cu. yd.	6	420
619C	18 cu. yd.	4	280

FOUR-WHEEL TRACTOR



660	54 cu. yd.	V-8	560
650	44 cu. yd.	V-8	560
632	38 cu. yd.	6	420
630B	30 cu. yd.	6	420

TWO-ENGINE TRACTOR



657	44 cu. yd.	V-8 (tractor) 6 (scraper)	980
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666	54 cu. yd.	V-8 (tractor) 6 (scraper)	980
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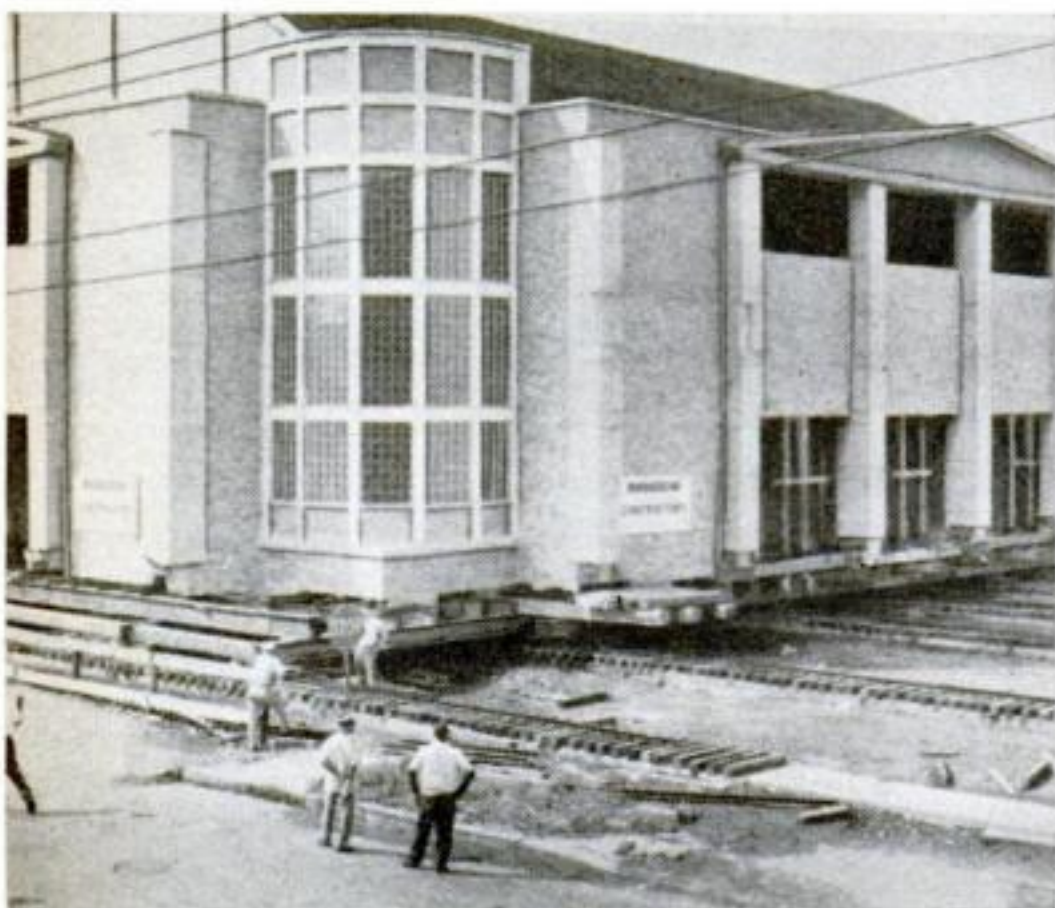
MOBILE SCAFFOLD rides up and down on cables from the top, swings out to move horizontally.



COLD WINDS blow hard 800 feet above ground, so window washers dress warmly. The elevator has a two-way radio and a chemical toilet.

Window-washing elevator

Windows in the new 60-story Chase Manhattan Bank in New York City are never opened because the building is completely air conditioned. The outsides are washed from a special elevator, built to fit around the exterior columns of the building, and operated by push-button controls. A five-man crew takes a full month to clean all of the building's 8,800 windows.



Church inches toward new site

Raised from its original foundation and lowered onto multiple parallel tracks, the 1,700-ton steel-and-concrete Progressive Baptist Church in Chicago was rolled to a new site one block away. The moving job took three weeks. The entire project is expected to take six months.



Scarecrow goes modern

Resembling halloween masks, heads of cats now hang in Austrian orchards to drive birds away from the fruit.

Shaped from metal and painted black, the faces have glass-filled cutouts for eyes and mouth that reflect sunlight. Suspended from a single cord, they swing and sway in any breeze, proving more effective, the Austrians say, than the former clothes-draped wooden crosses.



Tripod for a car

Suction cups attached to a car's windshield or window, plus a telescopic leg that rests on the floor, support this new West German tripod designed for taking photographs from a car. For additional firmness, an elastic band hooks under the car's dash. A sliding screw in the tripod head fits all standard movie and still cameras.

The mount permits the camera to be moved close to the windshield, minimizing reflection, so you can shoot roadside scenes as you drive. Veigel Photogeraete, Ludwigsburg, makes the tripod.



Moneybag captures would-be thief

A holdup man who tries to snatch this bag from a bank messenger will be sorry. The British device does these things in quick succession:

When the messenger lets go of the handle, he triggers a two-second time-delay switch that locks the handle on the thief's hand like a vise. Next, telescoping steel arms shoot out in three directions to balk escape in a car or through a doorway. To cap it off, a whistle blows continuously until police take over.



No klieg lights are needed here to provide . . .

Television by starlight

Army engineers at Fort Belvoir, Va., have developed a new TV-camera pickup tube that needs only starlight, moon-



. . . headquarters ringside seat at battlefield.

light, or sky glow to transmit a picture of enemy night movement to a monitor screen behind the battle line. To present a clear image, the tube intensifies diffused light reflected from the target.

Testing the Granddaddy of the Compacts:

By Devon Francis

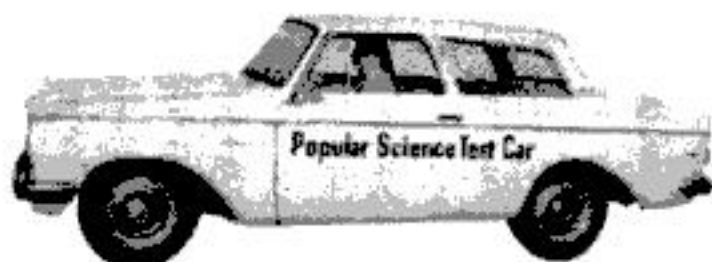
ON A crisp day last December, POPULAR SCIENCE took delivery of a Rambler American. It was the ninth in a series of cars subjected to punishing treatment to prepare these reports for you. It was a two-door Custom job with a cast-iron, six-cylinder engine of 125 horsepower. Without a clutch pedal, it came equipped with the new E-stick transmission [PS, Nov. '61, p. 64]. Called the "poor man's automatic," this is a technically fascinating combination of three-speed manual shift and automatic clutch.

The Rambler American is not the most

popular U. S. compact car. But it's the oldest. It's the smallest. And certainly it's one of the sturdiest. It is stubbornly unique. It refuses to conform to Detroit's standard pattern for scaled-down automobiles. It doesn't belly-down to the ground. It's almost free of gimmicky come-ons. It carries a sassy, take-me-as-I-am air.

The car looks little like the Rambler (see p. 63) introduced 12 years ago. It's been restyled. In 1950 it measured 175 inches, bumper to bumper. It had 82 horsepower. It was small, cute, and utterly lonely in a slough of standard Detroit vehicles that were growing steadily longer, wider, lower, and heavier. It

HOW THE RAMBLER AMERICAN DID



THE PERFORMANCE

Total distance covered . . .	10,002.3 miles
Gasoline used (nonpremium) . . .	479.8 gal.
Average miles per gallon . . .	20.9
Oil burned . . .	3.5 qt.
Gas mileage at constant speeds	
30 m.p.h.	28 m.p.g.
40 m.p.h.	26.6 m.p.g.
50 m.p.h.	24 m.p.g.
60 m.p.h.	21 m.p.g.
Gas mileage in stop-and-go driving	17.5 m.p.g.
Acceleration	
0-60 m.p.h.	14 seconds
40-60 m.p.h.	6.6 seconds
50-70 m.p.h.	9.1 seconds

Top speed	92 m.p.h.
Speedometer error	
Indicated Speed	Actual Speed
40 m.p.h.	38.9 m.p.h.
50 m.p.h.	48.6 m.p.h.
60 m.p.h.	58.1 m.p.h.
70 m.p.h.	68 m.p.h.

THE COSTS

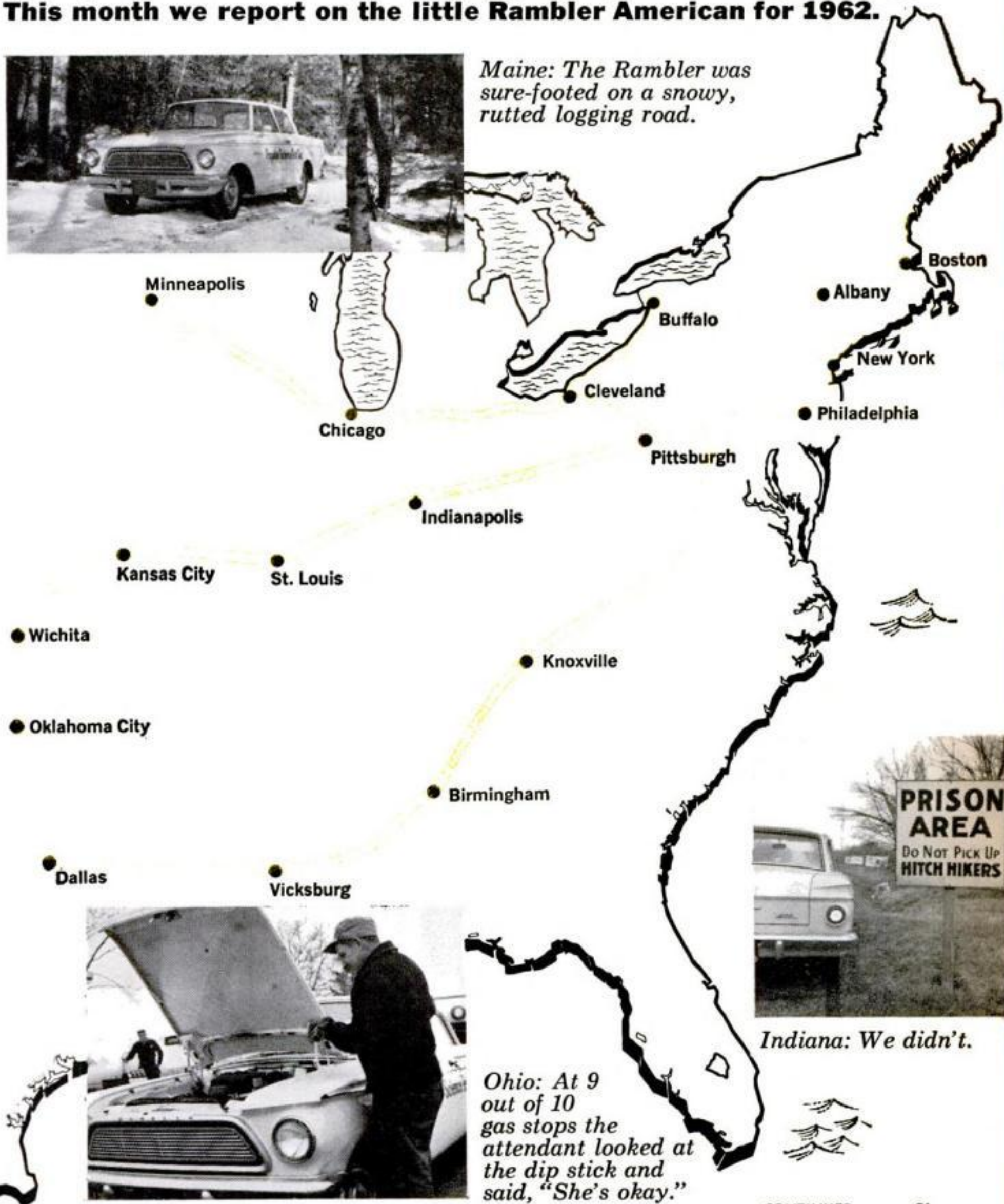
Gasoline	\$150.79
Oil burned	2.28
Gas-oil cost per mile0153
Repair and maintenance, including adjustments at 500, 1,000, 5,000, and 10,000 miles	
Oil and filter changes	\$15.30
Lubrication	2.00
Replacement parts	11.90
Total labor	17.95
Total	\$47.15
Overall direct operating cost per mile020

TWO years ago last January, Popular Science published the first of a series of articles on compact cars. The cars marked a new era in U.S. auto making. The articles were something special, too—they established a new kind of automotive reporting.

Successively, we drove the Chevy Corvair, Ford Falcon, and Plymouth Valiant; then the Olds F-85, Pontiac Tempest, and Dodge Lancer; then the Chevy II and Ford Fairlane. Each of them racked up 10,000 miles in one month—roughly a year's average driving. This month we report on the little Rambler American for 1962.



Maine: The Rambler was sure-footed on a snowy, rutted logging road.



Ohio: At 9 out of 10 gas stops the attendant looked at the dip stick and said, "She's okay."



Indiana: We didn't.

CONTINUED



Missouri: In one of the season's worst snowstorms the American paused briefly to get chain shoes on the rear wheels.



Minnesota: On several mornings it was necessary to scrape ice off windshield and windows before the day's driving.



New York: Gas mileage at constant speeds was measured—as on Chevy II and Fairlane—with Ongara Mark 10 analyzer.

found a market for a few years, disappeared from the showrooms, and then came back to improve its popularity amid a swelling group of vehicles that—since autumn, 1959—have been growing steadily shorter, narrower, and lighter.

The 1962 American is even shorter than its ancestor—at 173 inches, by two inches. But it boasts eight more horsepower in a regulation flathead engine and 43 more in an overhead-valve version of the same displacement.

POPULAR SCIENCE purchased its Rambler from a regular dealer for \$2,302. Its only accessories, aside from the E-stick automatic clutch, were a radio, heater, outside mirror, and front seat belts.

Now read the PS staff's round-table discussion of this car:

Fuel Consumption

Alex Markovich: I'm surprised, from a look at the log, at how widely the gas mileages varied.

Hubert Luckett: Not surprising when you consider the different driving habits of the people involved.

Markovich: I managed 21.2 miles to the gallon on one 322-mile stretch. But one of you guys racked up only 17.1.

Henry Comstock: That was me. It included 30 miles in second gear in a snowstorm.

Devon Francis: Evidently I got the highest reading—one 339-mile stretch gave me 24.6 miles to the gallon.

Howard Allaway: The gas mileage was good but not spectacular. I got between 19 and 20, but I was pushing it hard.

Francis: That 3.78 axle probably doesn't help any. The car's boxy, too.

How Rambler American compared with PS's '62

	Rambler American
Overall average miles per gallon.....	20.9 m.p.g.
Gas mileage at constant speeds	
30 m.p.h.	28 m.p.g.
40 m.p.h.	26.6 m.p.g.
50 m.p.h.	24 m.p.g.
60 m.p.h.	21 m.p.g.
Miles per gallon in stop-and-go driving.....	17.5 m.p.g.
0-60 acceleration	14 sec.
Top speed	92 m.p.h.
Total oil consumption	3.5 qt.
Gas-oil cost per mile.....	\$.0153
Overall direct operating cost per mile.....	\$.020

Rambler Was First of the Compacts

Small, spirited, and easy on gas, the Rambler—now known as the Rambler American—was introduced in the spring of 1950. Its 100-inch wheelbase hasn't changed since. Its turning radius was only 19 feet. Seating five, it weighed 2,600 pounds. The cruising speed was 65 m.p.h.



There's a good deal of wind resistance from that boxiness.

Frank Rowsome: Let's not forget that the oil mileage was fine. The engine burned less than a quart for each 2,000 miles.

Comstock: I put in one quart in 2,800.

Handling

Allaway: Any discussion of the handling centers on that E stick.

Markovich: Right. And tell me why, if you're going to shift gears anyway, you would pay extra for an automatic clutch? It actually affords you a lot less control than a manual clutch does.

Rowsome: I think it may make sense in the salesrooms. You get most of the convenience of an automatic for less money.

Comstock: There's a trick to shifting

smoothly—you back off on the accelerator just a hair.

Rowsome: Yes, but a split second after you start the shift. It's very easy to drive it adequately, but it does take care to do it dead smooth, especially in coordinating the shift lever and gas on the one-two shift.

Luckett: Anybody notice that you embarrassed yourself at least once at the start by hitting that long brake pedal for a clutch pedal?

Allaway: Embarrassed isn't the word. I almost threw myself

through the windshield.

Markovich: I had trouble when the car was new. The shift wouldn't stay put. It kept slipping out. The microswitch was throwing the clutch out. I had to hold the lever in high gear.

Allaway: Shucks, that was a simple fix. It took two minutes and a screwdriver.

How the Rambler's Tires Stood Up

A tire expert measured tread depth of the 6.00-by-15 Goodyears (rotated once) at 10,002 miles. Left front, right front, and left rear tires had lost 25 percent of their tread; right rear, 20 percent; spare, 5 percent. His estimate of projected life: 35,500 miles on four tires, 44,300 on five switched tires

Ford Fairlane and Chevy II; '61 Tempest, F-85, and Lancer; '60 Corvair, Falcon, and Valiant

Fairlane	Chevy II	Tempest	F-85	Lancer*	Corvair	Falcon	Valiant
18.3 m.p.g.	21.2 m.p.g.	20.25 m.p.g.	20.21 m.p.g.	16.3 m.p.g.	23.43 m.p.g.	26.56 m.p.g.	20.31 m.p.g.
26 m.p.g.	29 m.p.g.	28.4 m.p.g.	27.9 m.p.g.	21.8 m.p.g.	26.6 m.p.g.	30.2 m.p.g.	25.8 m.p.g.
24.5 m.p.g.	27 m.p.g.	27 m.p.g.	26.8 m.p.g.	20.8 m.p.g.	24.2 m.p.g.	29 m.p.g.	24.2 m.p.g.
22 m.p.g.	25 m.p.g.	24.9 m.p.g.	24.9 m.p.g.	18.4 m.p.g.	23.6 m.p.g.	28.1 m.p.g.	23.9 m.p.g.
20 m.p.g.	24 m.p.g.	22 m.p.g.	21.6 m.p.g.	16.1 m.p.g.	22.6 m.p.g.	27.1 m.p.g.	22 m.p.g.
16.9 m.p.g.	20 m.p.g.	18.7 m.p.g.	15.03 m.p.g.	13.8 m.p.g.	21 m.p.g.	22.4 m.p.g.	19.6 m.p.g.
13.1 sec.	17 sec.	13.5 sec.	13.8 sec.	11.2 sec.	17 sec.	22.9 sec.	17 sec.
100 m.p.h.	90-plus	96-plus	100-plus	92 m.p.h.	88 m.p.h.	78 m.p.h.	96 m.p.h.
None	None	1 qt.	4 qt.	4 qt.	4 qt.	1 qt.	3 qt.
\$.0174	\$.0153	\$.0163	\$.0162	\$.0203	\$.0145	\$.0122	\$.0163
\$.0183	\$.0181	\$.0186	\$.0172	\$.0246	\$.0184	\$.0147	\$.0206

*Lancer had optional larger engine, automatic transmission, and special "performance" axle.

CONTINUED



Kansas: Friction tape was strapped on chrome of steering wheel to kill panel-light reflections in windshield.



Tennessee: At exactly 5,050 odometer miles, Rambler's wheels were rotated, using the spare, to equalize wear.

Francis: It's an awkward transmission on a cold morning on fast idle. You have to tromp on the brake to keep the car from creeping. Or else move the shift lever just enough to operate the micro-switch, which keeps the car from churning off on its own.

Rowsome: I thought that the E stick was just a bit uneasy-making on ice.

Markovich: Since you can't double-clutch, the car could use a synchronized first gear for mountain grades.

Comstock: Maybe so, but the E stick is just what I want for starting on an upgrade—just use your left foot on the brake and your right on the accelerator.

Allaway: It seemed to me that brake took a lot of leg power.

Rowsome: And the parking brake a lot of arm power.

Allaway: But the brakes were smooth all around, even in pulling down on a real hard stop.

Luckett: The steering is much better than that on the older Ramblers, which was poor. It's moderately light, quick, and pleasing. But did any of you heel

and start skittering on cowboy turns?

Comstock: I certainly didn't. If the car's that unstable, how did I manage to stay out of the ditch in that snowstorm? I counted 14 cars off the road.

Rowsome: You'd said your prayers.

Francis: Then I must have said mine, too. I was uneasy hitting the Pennsylvania Turnpike in a snowstorm with a car I wasn't acquainted with. The truck traffic was terrific. But she gave me no trouble at all.

Markovich: I was forced off a two-lane road on one occasion by an oncoming car on a curve. The shoulder was soft, too. But the Rambler kept its feet.

Allaway: All told, it's a solid-handling car. I felt comfortable cruising between 60 and 70. It kept firm on wet roads with an occasional skim of light snow or ice.

The Ride

Francis: The ride's hard, period.

Rowsome: The car's sprung hard, all right, but isn't there a reason for it? Put it in your garage and see how really tiny

[Continued on page 190]

How Well Was It Designed and Built?

The Rambler American that POPULAR SCIENCE drove provided dependable transportation. Like all cars, it showed some flaws in design and assembly. Here are some notations from the logbook:

- Chrome on the steering wheel reflected in the windshield.
- The heater thermostat was hard to adjust.
- Windshield wipers tended to stall

when working under acceleration loads.

- Door latches pinched careless fingers.
- Vent panes were noisy at high speed even when shut tightly.

On the other hand, the car was unusually free of rattles, except for a shift-linkage clatter on sharp bumps. And after a 200-mile run in a downpour, the car did not leak a drop in either the passenger compartment or trunk.



New Pontiacs set speedway records for stock cars

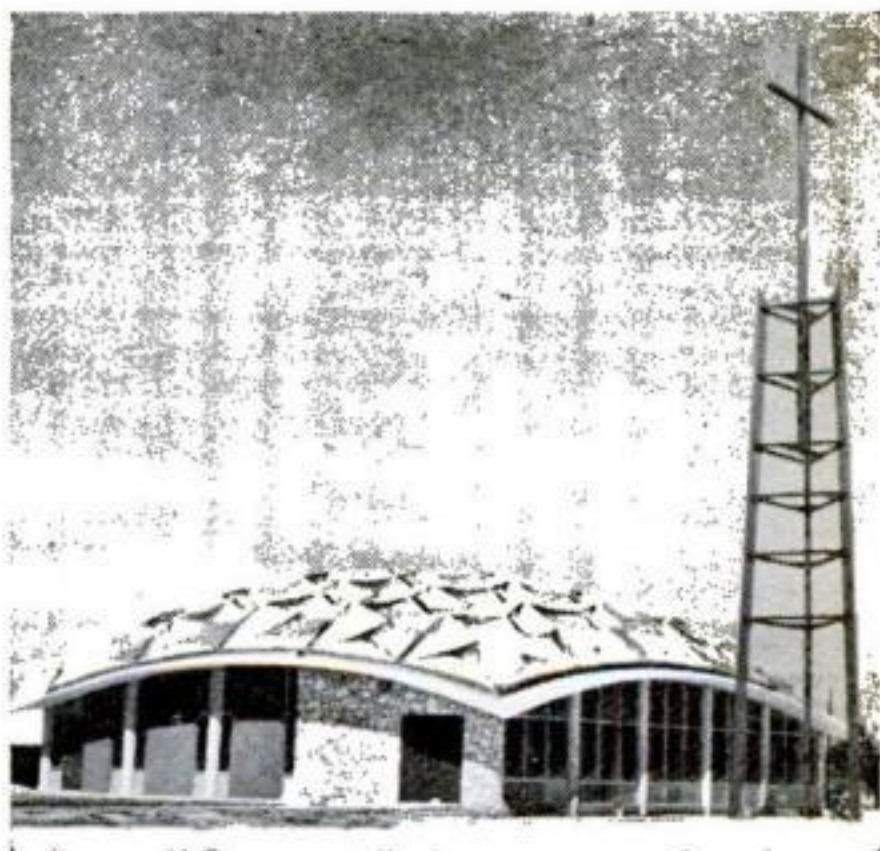
With the help of a fork lift, two 1962 Pontiac sedans recently broke three stock-car records at the Indianapolis Speedway. They were: 107.787 m.p.h. for

a 24-hour run; 113.292 for 500 miles; 122.132 for one lap. Fork-lifting the entire car enabled pit crews to change all four tires during 40-second stops.



Out goes the can opener

Two new self-opening cans may make your can opener obsolete. Pull a metal tab on one, and the whole top comes off. On the other, a beverage can, lifting off the tab opens a pouring spout, like that made by a beer-can punch. Called "Pull-tops," they're made by Can-Top Machinery Corp., Philadelphia.



Gold roof shines out on church

A gold-anodized aluminum dome adds beauty to the new First Methodist Church in Riviera Beach, Fla. It's said to be the first time geodesic construction has been used for a church. The dome is 85 feet across and covers a 6,300-sq.-ft. floor space that can seat 552. Its height at the center is 14½ feet.

How Coin Machines Detect Phony Money

Mechanical cunning has given vending machines a fussy appetite that refuses to digest anything but the real McCoy

By C. P. Gilmore

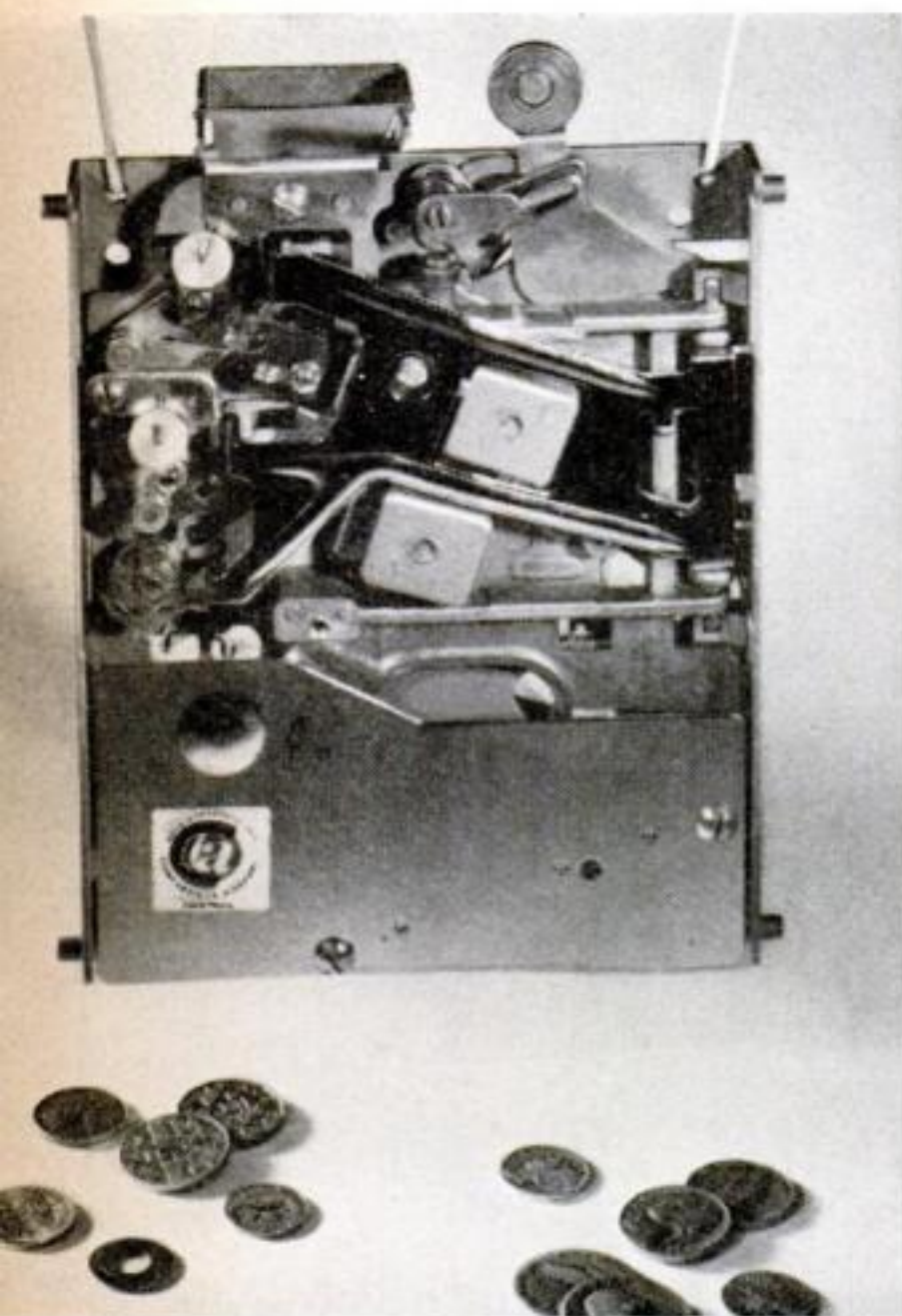
DROP a coin into a soft-drink or cigarette machine. For about a second, you'll hear a series of metallic clunks and gurgles while the machine decides if the coin you deposited is a product of the U.S. Mint, or if you make your own.

The mechanical money manipulator that separates the bogus from the bona fide is the latest weapon in a battle that started more than a half-century ago between machine makers and those who consider the robot salesman a challenge. These slug-rejector mechanisms—some companies call their products coin acceptors—are miniature but highly sophisticated testing laboratories. They gobble up nickels, dimes, quarters, and perhaps pennies and halves as well, depending on design. They run each coin through an obstacle course of tests, spot the specious specie, accept the authentic, and spit slugs back at you as fast as you can shove them in the slot.

It wasn't always that way. Early in the century, when vending machines were just coming into general use, the country was a machine slugger's paradise from coast to coast. The early robot retailers would gulp down almost anything roughly the right size; the slug didn't even have to be metal. One operator found his machine empty of merchandise. The cash box was damp, but empty. He finally discovered the secret. One pains-taking slugger had made a batch of nickel-size molds, filled them with water, frozen them. He could clean out a machine in minutes. Furthermore, the evidence melted almost immediately.

Other slugs were easier to carry than ice and worked just as well. By the late 1920s, light-fingered linotypists could make a mold and, from the molten metal in their machines, cast a pocketful of slugs automatically. Iron washers the right size would work in many machines, as would aluminum mills used to collect taxes in some states, fiberboard tokens, and a variety of homemade phony cash.

Claud Trieman, President of Coin Acceptors, Inc., one of



HEART of the coin machine is this accept-reject mechanism. At left: penny, foreign coins, washer, subway token that machine spat out. At right in picture: honest dimes, nickels, and quarters.

fingered linotypists could make a mold and, from the molten metal in their machines, cast a pocketful of slugs automatically. Iron washers the right size would work in many machines, as would aluminum mills used to collect taxes in some states, fiberboard tokens, and a variety of homemade phony cash.



the leading manufacturers, told me how he remembers seeing some kids in his neighborhood "make money." They simply put nickels on a street-car track, turned them over after each car passed, and measured them against a genuine quarter until they were the right size.

Not everyone was so ambitious. But no matter. If you didn't want to make your own, it wasn't hard to find a commercial product. Pulp magazines of the day carried blatant ads for slugs the size of a dime. Price: 10 for a penny. The ads shouted in bold type: NOT TO BE USED IN VENDING MACHINES—just in case any reader was slow to catch on.

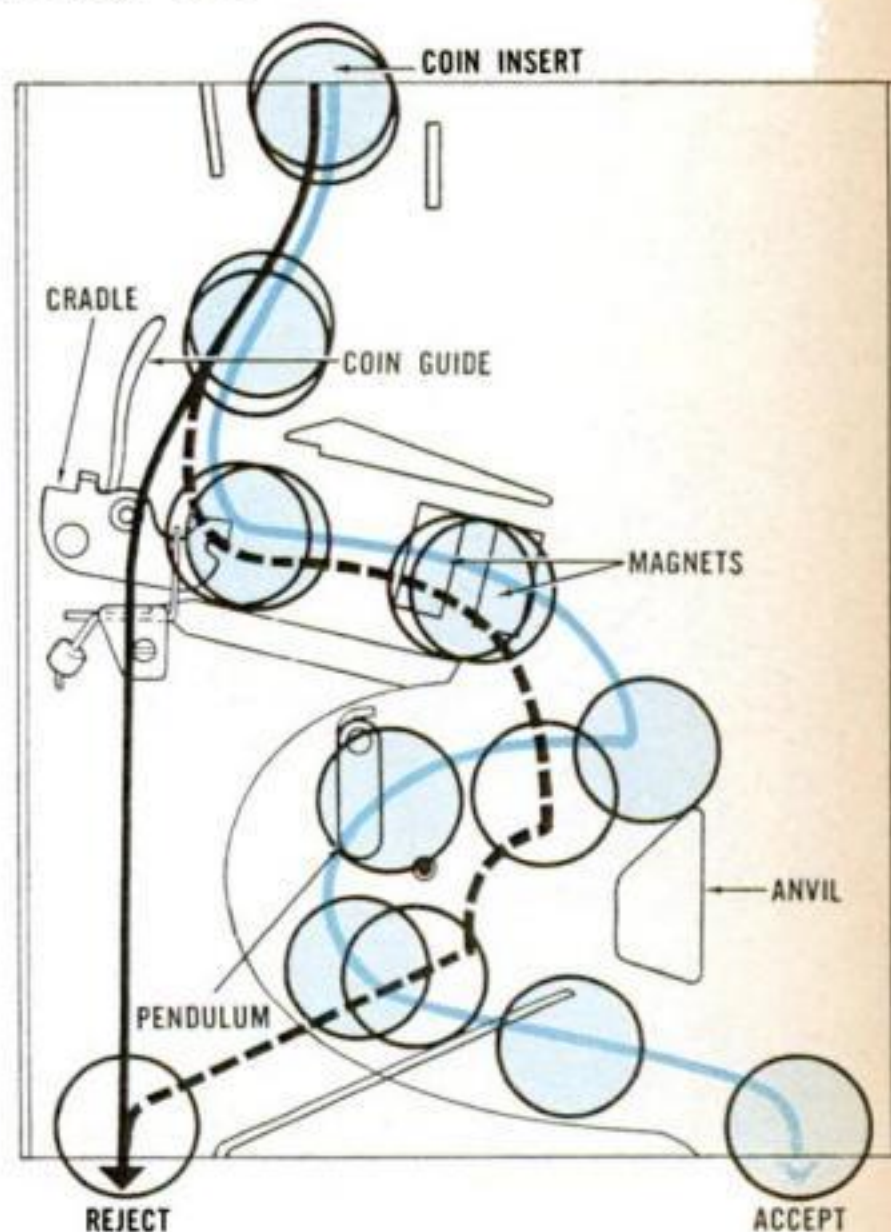
ABOUT that time, a young New Englander, who was to play an important part in the battle against slugs, entered the scene. The time: 1928. Nathaniel Leverone, a slim young man waiting for an elevated train in Chicago, put a penny into a platform scale. He weighed 208 pounds. Startled, he stepped on another scale, deposited another coin, found that he now weighed 70. A penny in a chocolate machine produced a dull clunk, but no candy. Maddered by the minute, Leverone put a fourth coin into a peanut machine. "Out came six moldy objects I wouldn't have fed to a billy goat," he said later.

Leverone figured there must be room in the world for a firm that would make and operate an accurate, honest, reliable vending machine. He put up \$5,000, found 11 friends willing to do the same, and established the Automatic Canteen Company—today one of the giants of the industry. But Leverone's young company almost didn't make it. He hadn't counted on the slug menace.

Leverone was in trouble before he knew it. He soon found he was taking in more slugs than money: \$30,000 worth the first year. Automatic Canteen, along with other firms in the business, went to work in earnest to beat the slugs.

Most machines at that time used a coin-col-

TO CATCH MOTORISTS who pitch bogus money into automatic coin collectors, the New York Thruway recently stationed cops behind one-way mirrors at the toll booths. One hundred and fifty people were arrested during a two-week period.



GOOD NICKEL, having passed through all the hurdles of the obstacle course, reaches the accept slot (via colored line). But bad coin or slug takes one of the other two paths (broken or solid black line). It is rejected if it is too big or too small, too thick or too thin, too light or too heavy, warped or perforated, or made of the wrong alloy.

lecting slide. You put your coin in a circular hole, shoved the slide and coin into the machine. The first improvement on this easy-to-beat mechanism: a magnet next to the slot where the coins dropped. It jerked iron slugs out of the track and into the rejection chute. Next, a three-fingered probe was installed to grab washers.

But slug makers were clever. Each new rejection device was followed at lightning speed by a slug that would get past it. In fast order, machine designers added a small anvil on which coins had to bounce. A coin too hard or too soft, too elastic or not elastic enough, bounced out. A set of iron fingers made precise measurements of the coin's diameter and thickness.

Next, engineers figured out a way to measure a coin's electrical resistance—and thus its metallic content—using a purely mechanical system.

Here's how the ingenious system—which is used in all rejectors to this day—works:

A COIN that gets through the sizing mechanism and past the fingers that jerk out washers now falls on an inclined plane. As it rolls down the decline, it passes between two magnets, then shoots off the end of the inclined plane in an arcing trajectory determined by its speed. If it is traveling at the proper speed, it hits a small anvil at exactly the right place, bounces into another carefully calculated arc, and falls precisely into an "accept" slot.

If the coin is of a magnetic substance—iron, for example—it never gets past the magnets. It sticks there, then is thrown into the rejection chute when the customer presses the coin-release button. But even if the coin is nonmagnetic—silver or copper, for example—the magnets play an important part in testing it.

As the coin rolls between the magnets, it acts like a small electrical generator. It is, in effect, a piece of metal cutting magnetic lines of force—the same thing that happens in a generator. This sets up small electrical currents—called eddy currents—in the coin. The eddy currents produce magnetic fields of their own which tend to oppose the magnetic fields of the fixed magnets. The net result: The two fields fight and the coin is slowed down.

Furthermore, the better the conductor a particular coin is, the greater the eddy current that is induced and the more the coin is slowed down.

When it rolls off the end of the inclined plane, if it is not rolling at exactly the right speed, it sails into the wrong trajectory and is rejected. The test proved to be extremely sensitive, so that a minute change in a coin's metallic composition would cause it to be rejected, even if its size and weight were perfect.

The magnetic-resistance test worked so well that by the time of the Chicago World's Fair in 1933, machine operators thought they had the slug makers beat. But a strange new development began showing up—not only at the fair but all across the country. Machine after machine was found empty of both merchandise and money.



THE OLD MILL was manufactured in 1916. For a penny you got a handful of peanuts and the chance that the rotating mill might scoop up a novelty.



COLLAR BUTTONS of genuine brass could be purchased for a nickel from this coin-operated device back in 1905.

beating a coin machine not dishonest but just a game

HERE'S what was happening. Crooks were drilling tiny holes in coins, attaching a fine thread. They'd drop the coin in the slot, get the merchandise, and pull the coin back out. A machine could be emptied in short order this way without depositing a single coin in the till.

To fight the trick, engineers put snippers in all machines to cut the string. "When somebody figures out a way to beat the machines," said Leverone, "it goes from coast to coast in a flash. We lost a fortune before we got snippers in all of our machines."

Over the years, as slug makers have designed better and better homemade money, coin acceptors have been continually improved and refined to meet these threats. One of the biggest improvements came in the middle 1930s, when an engineer named Ben Fry thought up a clever gadget called a cradle, now standard in all machines. It's nothing more than a pivoted plate with two pins attached. A coin falls between the two pins. If it is the right weight and size, the plate pivots and drops it in the proper chute. Otherwise, it is rejected. The cradle, in effect, weighs a coin and checks its diameter faster and more accurately than any device previously used.

It also made possible today's versatile rejector, which can accept three or four different coins—dimes, nickels, and quarters, for example—all through the same slot. Each coin simply falls through the quarter, nickel, and dime cradle, in that order. A coin won't be caught and pivoted through the proper accept channel until it hits the right cradle.

Although slug rejectors were pretty good by the late '30s, designers have continued to work to make them even better. Shortly before World War II, a number of peculiar silver-whitish slugs began showing up around Canton, Ohio. They were getting through the coin rejectors, and operators were in trouble. About the same time, copper slugs the size of a quarter began to be accepted in West Virginia by coin machines that should have known better. Engineers got busy on both problems.

THE metal in the white Ohio slugs, they found, was German silver, a mixture of copper, zinc, and nickel. It was traced to a nearby tableware plant where some employees had made a die and were punching out the worthless wampum from scrap. The West Virginia slugs were made from a rare, super-refined copper stock that was used in nearby electronics plants.

In both cases, the remedy was the same. The slugs, expertly made, were accurate enough in size and weight to get through. Their electrical resistance was close, too, but engineers found that they just barely passed this test. The answer: stronger magnets. These separated the trajectories of genuine and fake quarters a little more, and did the trick.

Robot salesmen are still not perfect, but it takes a real expert to fool them these days. And machine designers continue to look for ways to make them even better. Back

[Continued on page 204]



EARLY VENDOR delivered a stick of chewing gum from between the clown's teeth. Anything roughly the right size would make it work. Today's coin machines are considerably more sensitive.



LATE 19TH-CENTURY saw machines like this in London railway stations. They delivered postcards, stamped envelopes, and notepaper, but were easily fooled into taking a penny-shaped piece of lead.



ROCKY AND MOUNTAINOUS TERRAIN is no problem for a Bug. Base price, with three-speed gearbox, 5.38 rear end, and 12-inch wheels, is \$1,650. Brawny Bug, a \$150 option, offers tandem transmissions for six forward speeds, limited-slip 6.13 rear end, undercarriage crash pan, and 10-inch high-flotation tires. Cleated tires are also offered. There's plenty of head room for tall loads—because there's no roof. Bumpers are integral with frame. Though Bug is red-lined at 50 m.p.h., it can do more. Transmission and rear end are same as built for use in popular full-size cars.



Crosley Engine Sparks Cross-Country "Bug"



TUG VERSION has many commercial and industrial uses. Priced at \$1,800, it comes with standard transmission, over-engine seating, and eight-inch wheels. Here it's being used to ferry luggage from plane to airport terminal.



VINYL BODY ENCLOSURE makes the Bug an all-weather car. Other available extras include heater, power takeoff, dual rear wheels, 13-inch tires, and electric winch. Crofton also sells parts for all Crosley engines.

SO TINY it can be carried in a pickup, so gutsy it can run at highway speeds, so agile it can slog through sand and mud, so useful it totes a half-ton payload—that's the Crofton Bug.

Built in the five-acre plant of the Crofton Co. in San Diego, this abbreviated vehicle (wheelbase is a skimpy 63 inches) first caught on with lumbermen and sportsmen in the Northwest. Now its owners include prospectors, lifeguards (with high-flotation tires it scoots over loose sand), ranchers, and farmers.

At airports, the Bug hauls baggage and even tows light planes. It plows snow, hoists winch loads, and carries foursomes around golf courses. It's even been recruited into the Air Force. A model with smaller tires and a platform body—called the Tug— transports people and materials in industrial plants.

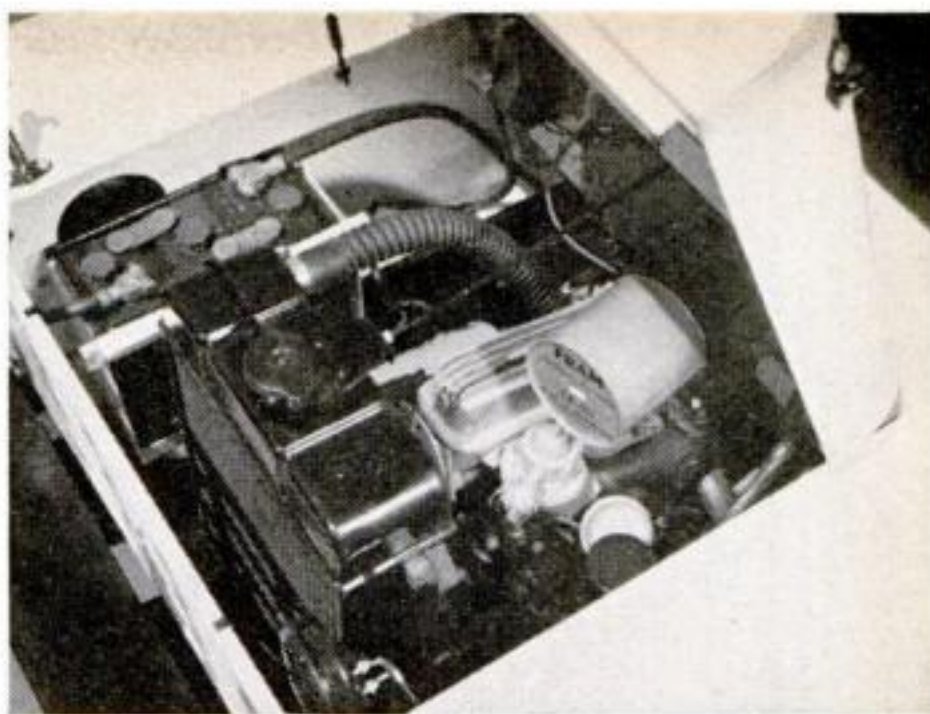
The Bug line had its start four years ago when W. Burke Crofton bought the rights (and \$2 million inventory) to the old Crosley auto engine from the Twin Coach Co. Crofton got Robert W. Jones, then an engineer with Twin Coach, to convert the engine into a successful marine inboard.

Jones had also worked for Packard, GM, and Rolls-Royce. In his spare time he cobbled a Crosley engine into a small chassis and used the result as a family runabout. After seeing it do its stuff, Crofton ordered more cars built and tested. From these he fixed on the models now on the market.

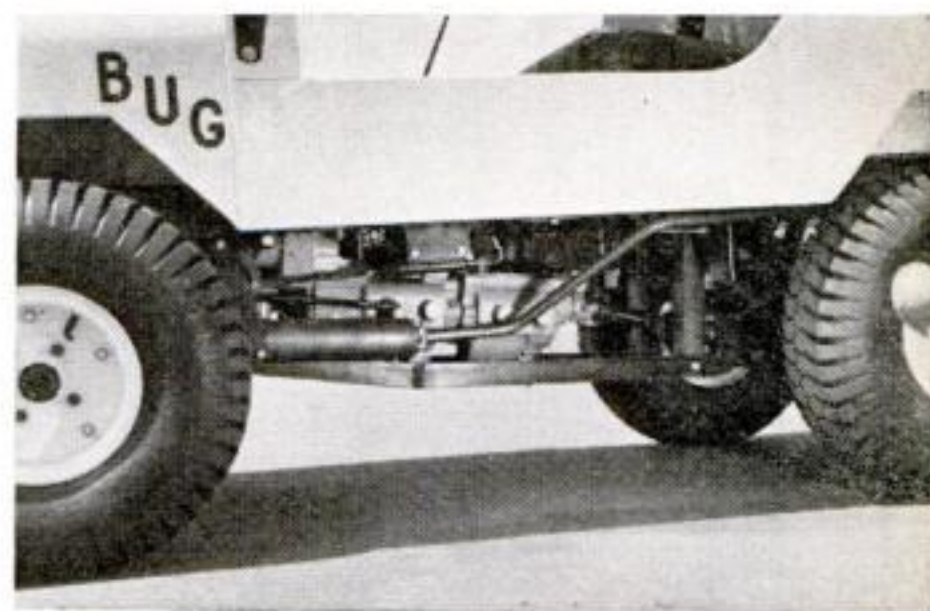
The Crosley engine, now called the Crofton 44, is an oversquare ($2\frac{1}{2}$ -by- $2\frac{1}{4}$ -inch bore and stroke) in-line four with 9:1 compression ratio. At 5,200 r.p.m., the little mill develops 35 hp.

A more powerful version is bored out to 53 cubic inches. With 10:1 compression ratio and dual carburetors, the Crofton 53 turns up 45 hp. This one costs \$165 extra.

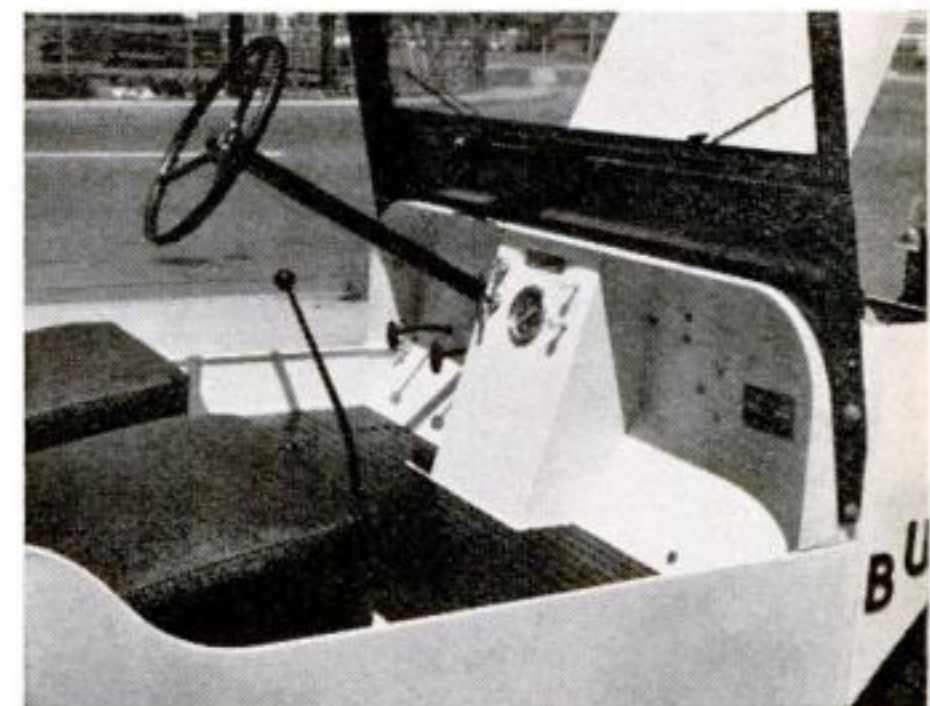
Prorated service is available to Bug owners. Crofton mechanics will overhaul the engine, clutch, and transmission of a Bug (removed and shipped to the factory) for a flat rate of \$12.50 for each month the vehicle has been in its owner's hands. Exchange units are also available for owners who are in a hurry.—Harry Walton.



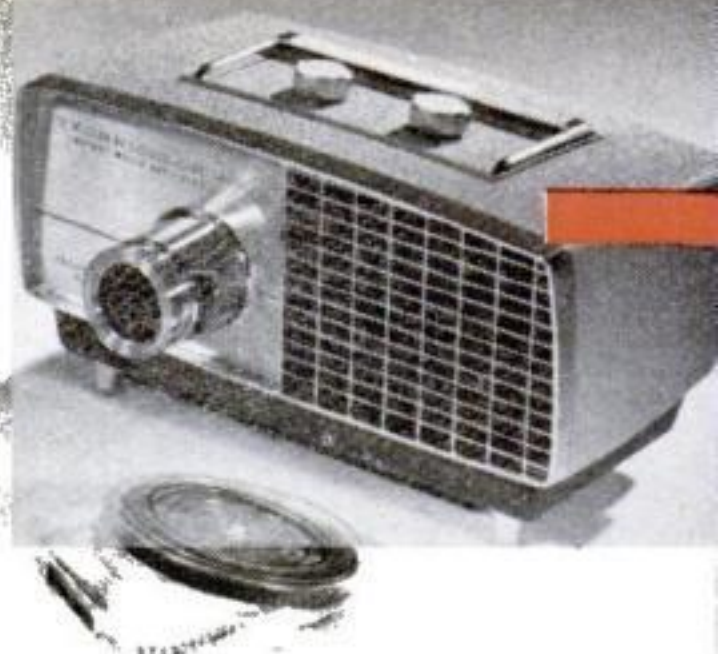
CROSLY ENGINE has five main bearings. Block is cast iron; crankcase is aluminum alloy. Overhead cam, driven by spiral gears at both ends of a vertical shaft, eliminates the need for push rods and rocker arms; valve clearance is adjusted by inserting shims in cam followers.



TANDEM TRANSMISSIONS give the Brawny Bug a low-low ratio of 12.4:1 for tremendous pulling power. Both units have synchromesh in second and high gear. Caution: Don't put both gearboxes in reverse—unless you want to go forward.

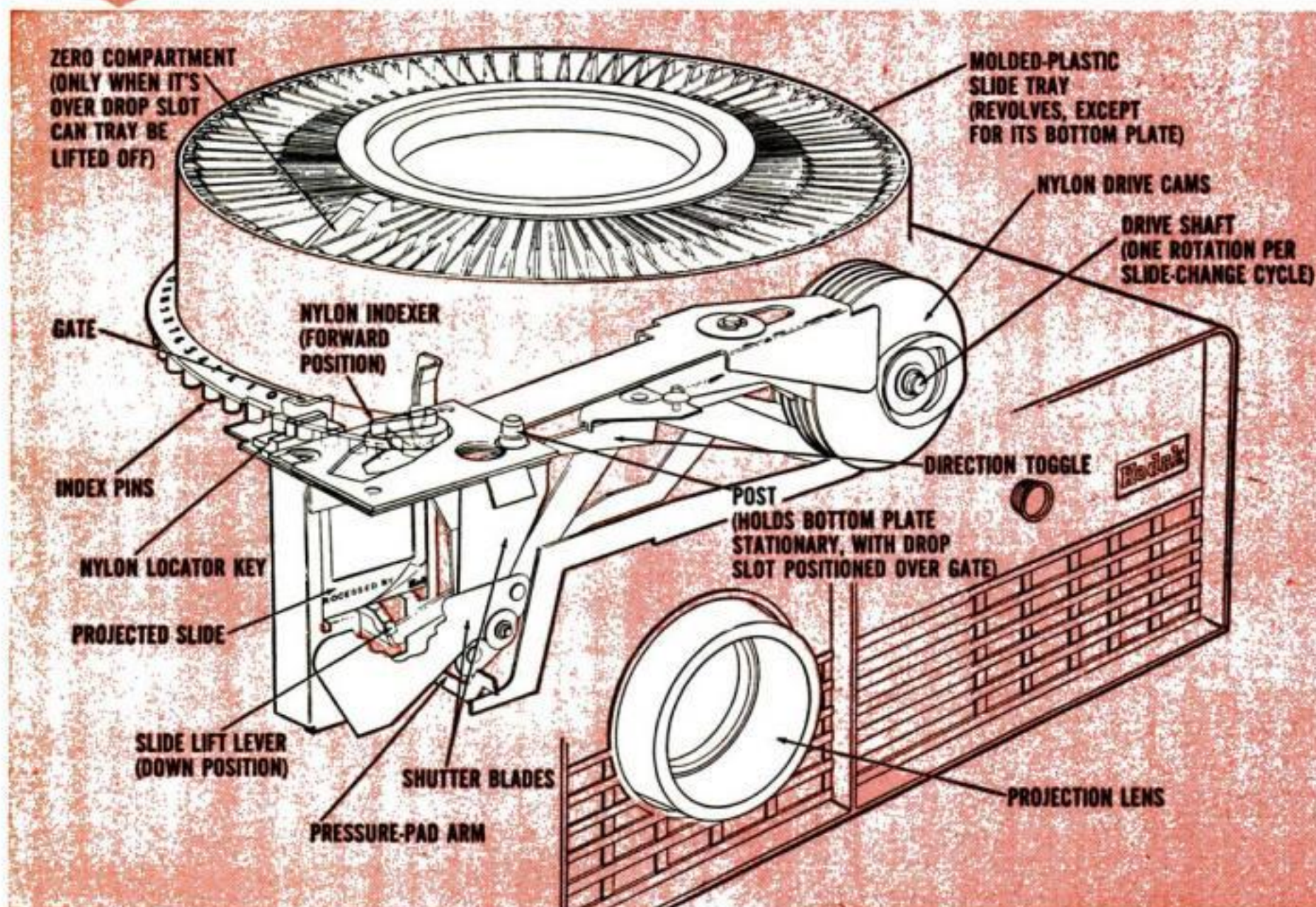


DRIVER'S COMPARTMENT includes all standard instrumentation such as speedometer; indicator lights for generator, oil pressure, and temperature; high-beam switch; turn signals; and one windshield wiper. Hand brake holds by toggle action, adjusts by turning a knob on top.



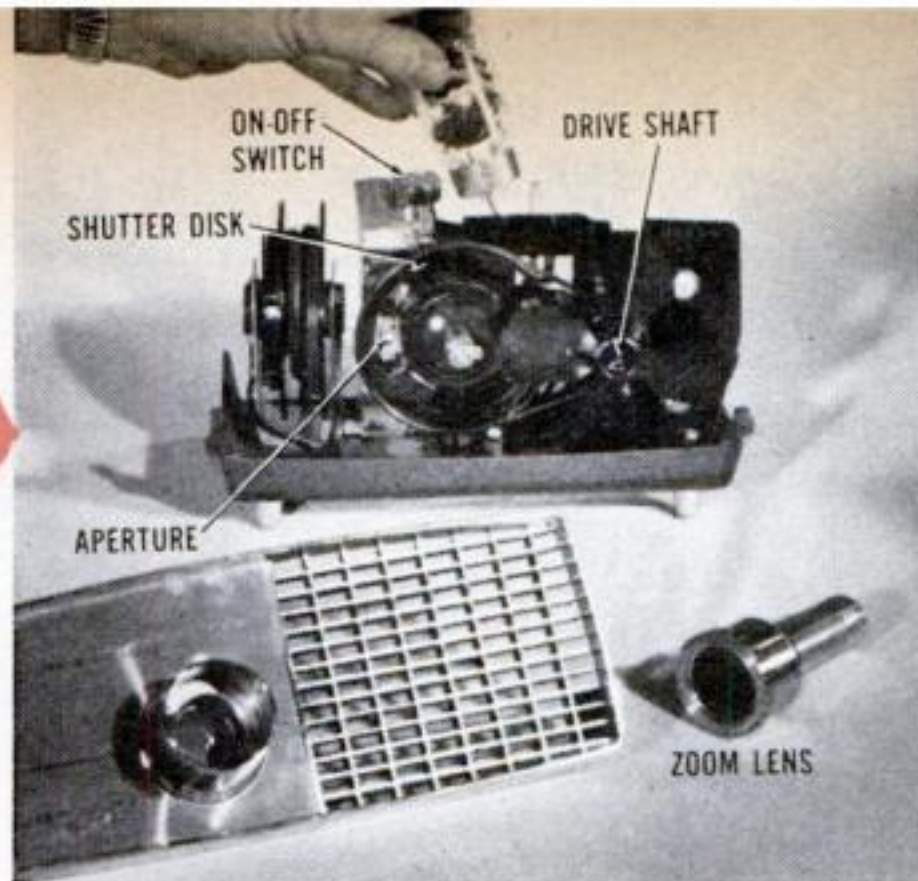
CONTENDERS FOR THE CROWN? The Carousel, left, seems to have copped it. Actually, that's a slide tray. Movie projector, right, uses cartridged film.

Sit back and enjoy yourself— New Projectors Put

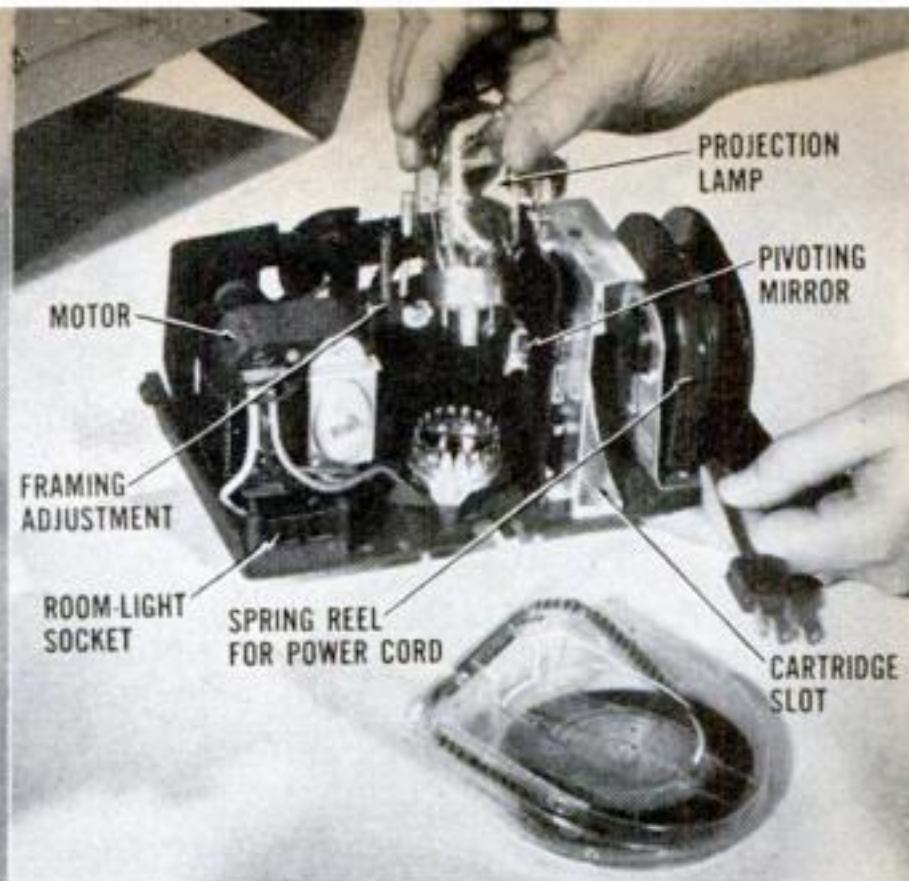


ONE ROTATION OF SIX FUSED CAMS triggers 10-step sequence: 1) Shutter blades scissor together to cut off light path; 2) toggle rotates indexer to forward position (unless reverse button is set); 3) lever lifts projected slide back into tray; 4) locator key retracts from between pins; 5) indexer pivots to position shown in

phantom outline, rotating tray one pin space; 6) locator key slips between pins again, to lock position; 7) pressure pad pulls back from gate rails; 8) lever drops, letting slide fall into projection position; 9) pressure pad closes to hold slide squarely against gate rails; 10) shutter blades open to let light beam pass.



STRIPPED-DOWN 800, seen from front, shows how drive shaft does double duty: Mounted on it is the cooling fan; belted to it is triple-slotted shutter disk that whirls past the aperture.



OFFSET LAMP, in rear view, has shield behind filament to direct beam through partition. Cartridge (foreground) has recess into which a mirror pivots to bounce light through film loop.

On the Whole Show

**Kodak and Technicolor models
—one for slides, one for movies
—move in mysterious ways.
Here's the PS report on them**

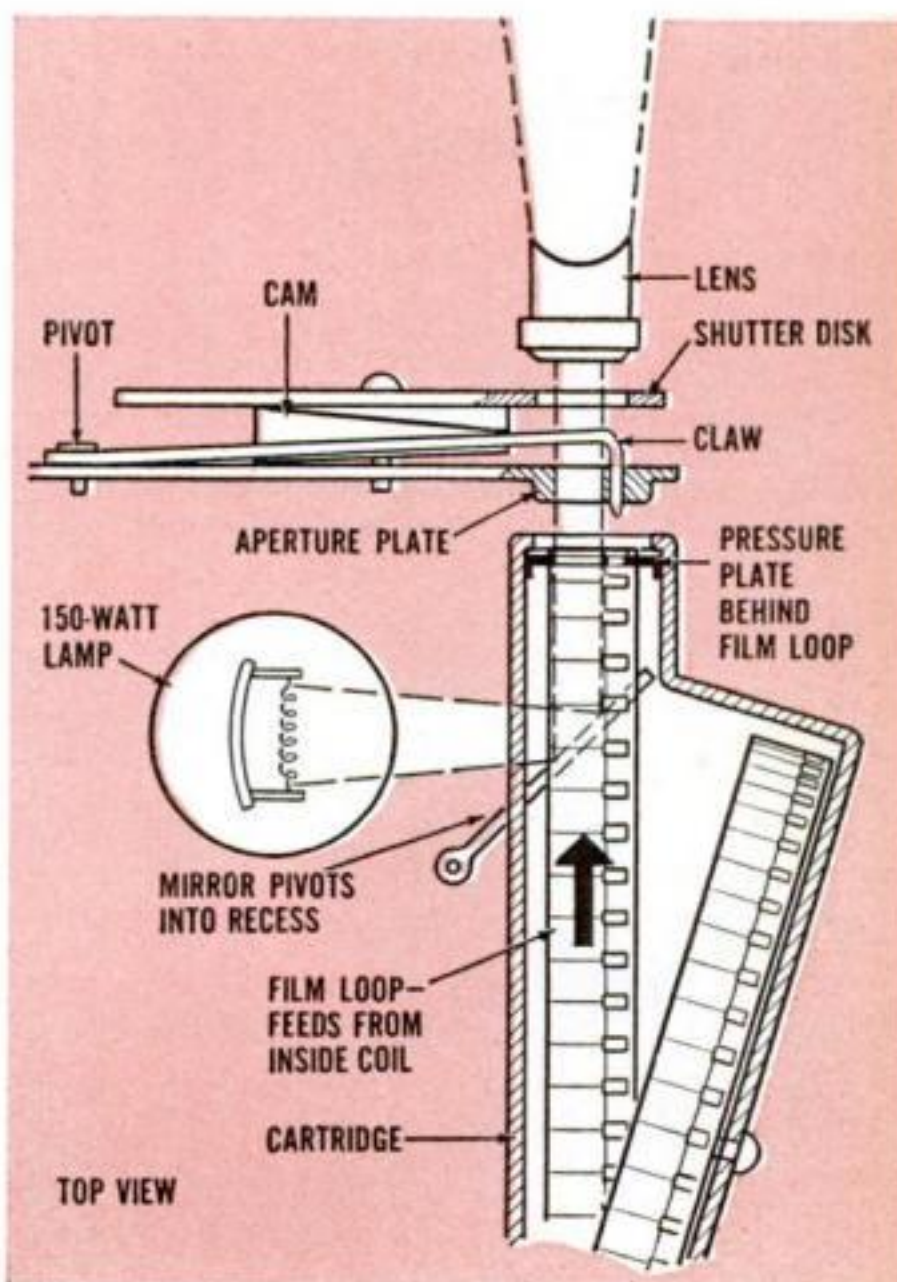
By Alfred W. Lees

THOSE two new projectors staring across at each other on the opposite page are not competing for the same loving cup. The little number on the right is, despite appearances, an 8-mm. movie projector. It's so style-conscious that it has renounced the Mickey Mouse ears that have always identified the breed. These external reels are replaced by the cartridge lying in front; it slips into a pocket behind the lens.

The big job with the crown is a slide projector whose trays (that crown is one of them) are "played" and changed like fat phonograph records, then stored on a book shelf like a set of encyclopedias.

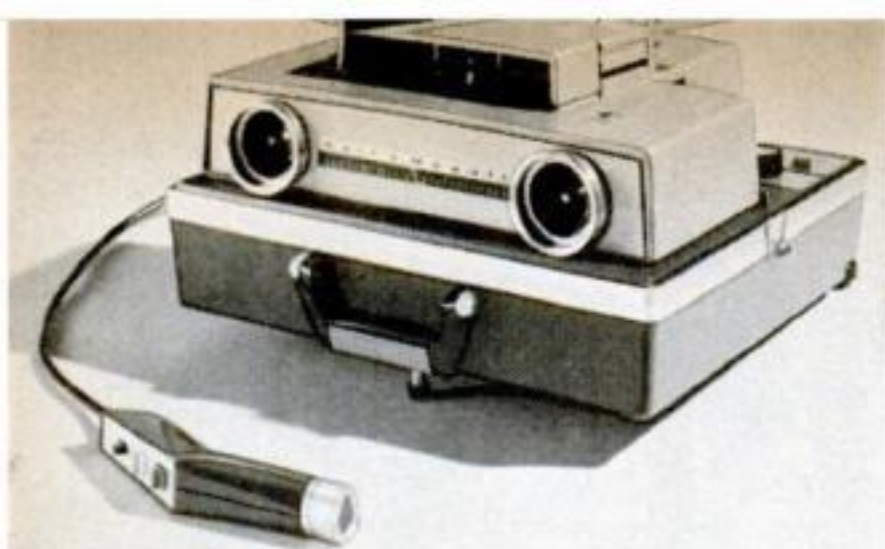
Both projectors are revolutionary in a double sense: Each represents a radical departure from familiar design—and each spins its pictures in a circle.

In each case, this ring-around-the-rosy has distinct advantages. The movie machine—Technicolor's 800 "Instant"—

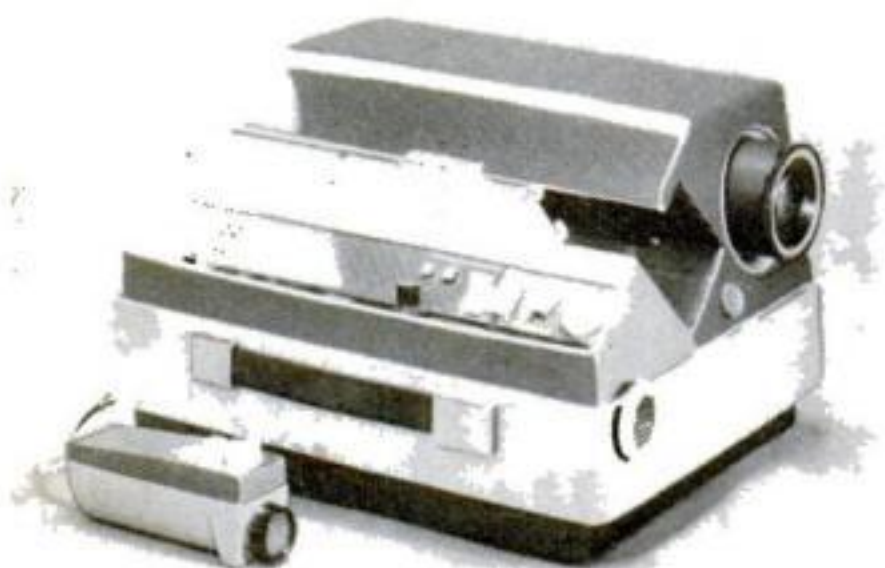


WITH CARTRIDGE IN PLACE, turning ON button lights projection lamp and pivots an angled mirror into recess behind film loop. Cam jigs claw up and down, in and out of sprocket holes, to pull strip past pressure plate, frame by frame, as synchronized shutter disk spins. Film pushes itself back onto outside of coil.

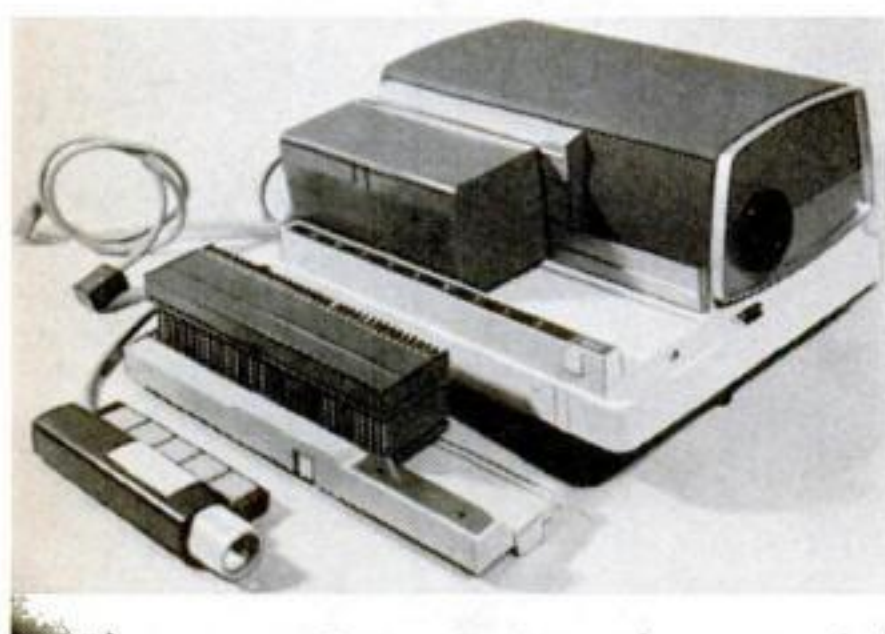
CONTINUED



THE SCREEN'S NEVER BLANK with the Bell & Howell Tandem-Matic. The twin lenses are part of duplicate optical systems flanking a 750-watt lamp. Sliding iris blade slowly fades out one slide while fading in the next, for a lap-dissolve effect that gives movie-like continuity. Up to 54 slides are loaded alternately into left and right tray compartments. \$300.



CORRECTIVE EDITING DURING SHOW is possible on the Anscomatic II—even though tray is tunnel-feed type. Top cover slides back to reveal slot through which slide can be inserted or retrieved. Other slots permit manual showing of 2-by-2 and 2 $\frac{3}{4}$ -by-2 $\frac{3}{4}$ mounts or half a stereo slide. Mixed mounts need no refocus. Auto-timing from 5 to 60 seconds. \$140.



JAMPROOF MAGNETIC ACTION floats slides in and out of the Honeywell 650, eliminating claws and levers. A steel channel is clipped to cardboard, plastic, or glass mounts; shuttling magnet draws slide into projector. Other novelties: optical adjustment and alternate tray adapt for 2 $\frac{3}{4}$ -by-2 $\frac{3}{4}$ mounts; all controls are remote, aren't duplicated on case. \$210.

Each of these new projectors also boasts an innovation

rewinds as it projects, eliminating that finger-tapping lapse between reels. Film isn't shunted from spool to spool in a long ribbon. The ends are spliced to form an endless loop coiled inside a clear-plastic cartridge. You're spared the fuss of weaving the film through a complex of sprockets.

The circular tray of the slide projector—Kodak's Carousel—holds such a generous load (80 slides) that one tray makes a good evening's program. And the gravity feed (slides march around until they drop into the projection slot) assures jamproof action.

The gentle touch. Both projectors treat your treasures with respect. When you own an 800, your movie film comes back from Technicolor processing already cartridge-sealed from dirt and fingerprints. And since the only mechanical prod to engage the perforations is the film-advance finger, there's no possibility of shredding or snapping film in a tug-of-war between sprockets.

The Carousel handles your slides with like tenderness: No angry claws force defective mounts into position. If one sticks halfway in the gate, you can easily retrieve it by lifting the tray. The Carousel even bathes slides with warm air so they won't pop out of focus when they drop into the hot projection beam.

As for lenses, an f/1.5 zoom is standard on the 800—so you can fit image size to screen area without dragging the projector back and forth. For the Carousel, a zoom lens is \$30 extra; with the standard 5" f/3.5 lens the price is about \$140. The 800 is just under \$100.

Setting up a show has never been easier. Both projectors cater to lazy or fumble-fingered adults. These are the people who get sold foolproof, automatic cameras capable of giving wall-size color stills or movies—then never get around to owning a projector. They squint into hand viewers or knock heads in front of table-model screens. The statistics are hard to believe: Technicolor executives told me that only one out of eight buyers of 8-mm. cameras gets a projector!

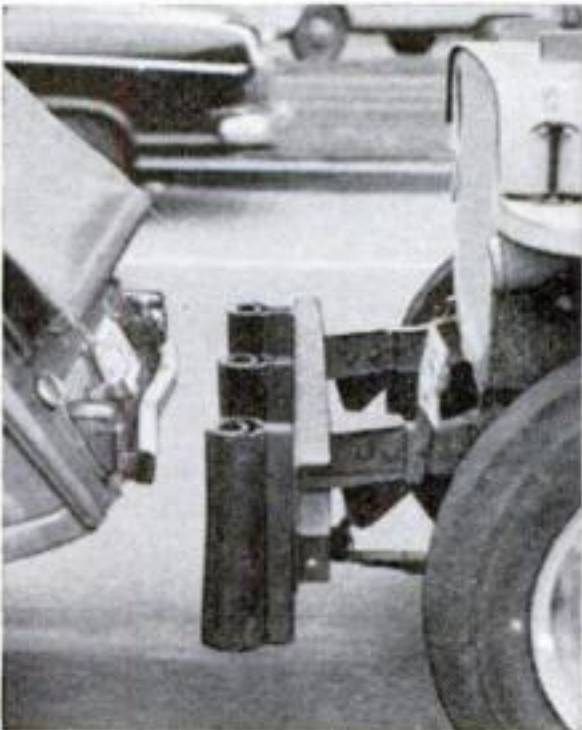
[Continued on page 200]



Television doctoring

A portable TV camera to help victims of highway accidents is demonstrated above by Paris gendarmes.

It can transmit close-ups of victims and their injuries for viewing by doctors on their office or home screens. The doctor is then able to give first-aid directions and supervise removal to an ambulance.



Adjustable bumper

Some garages in Brussels, Belgium, now use tow trucks equipped with rubber bumper attachments for pushing stalled autos.

The height may be raised or lowered to fit the rear bumper of any car, even the tiniest.



Pedal-pushing recharges battery

Should the lights in a fallout shelter go out, a ride on this stationary bicycle might put them back on again. Housed in its frame is a combination transistorized inverter and converter. House current flowing through the Dynamic Shelter Cycle keeps an attached storage battery fully charged.

When the electricity goes off, the unit provides current for 200-300 hours to operate fluorescent lighting, air-filtration pumps, and other emergency needs. Five minutes of pedaling for every hour of electricity consumed recharges the battery. The device is made by Dynamic Instrument Corp., Syosset, N. Y.

Skin diving for gold

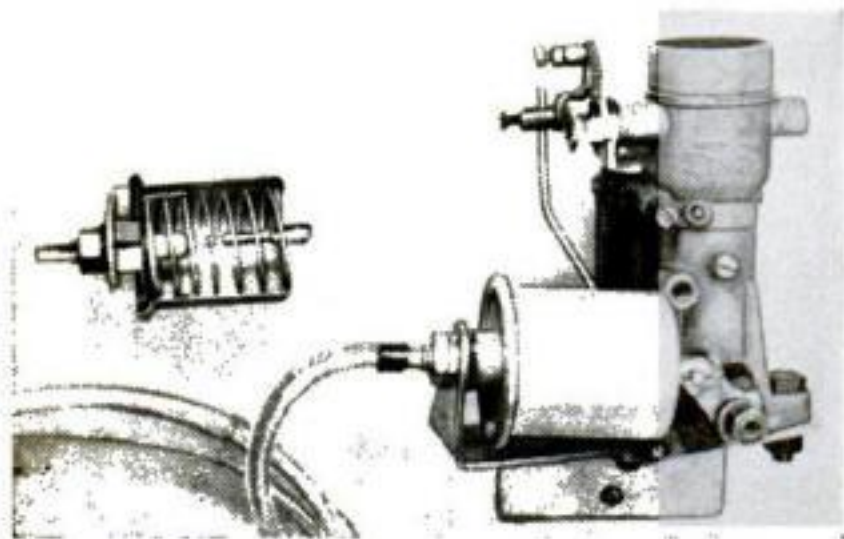
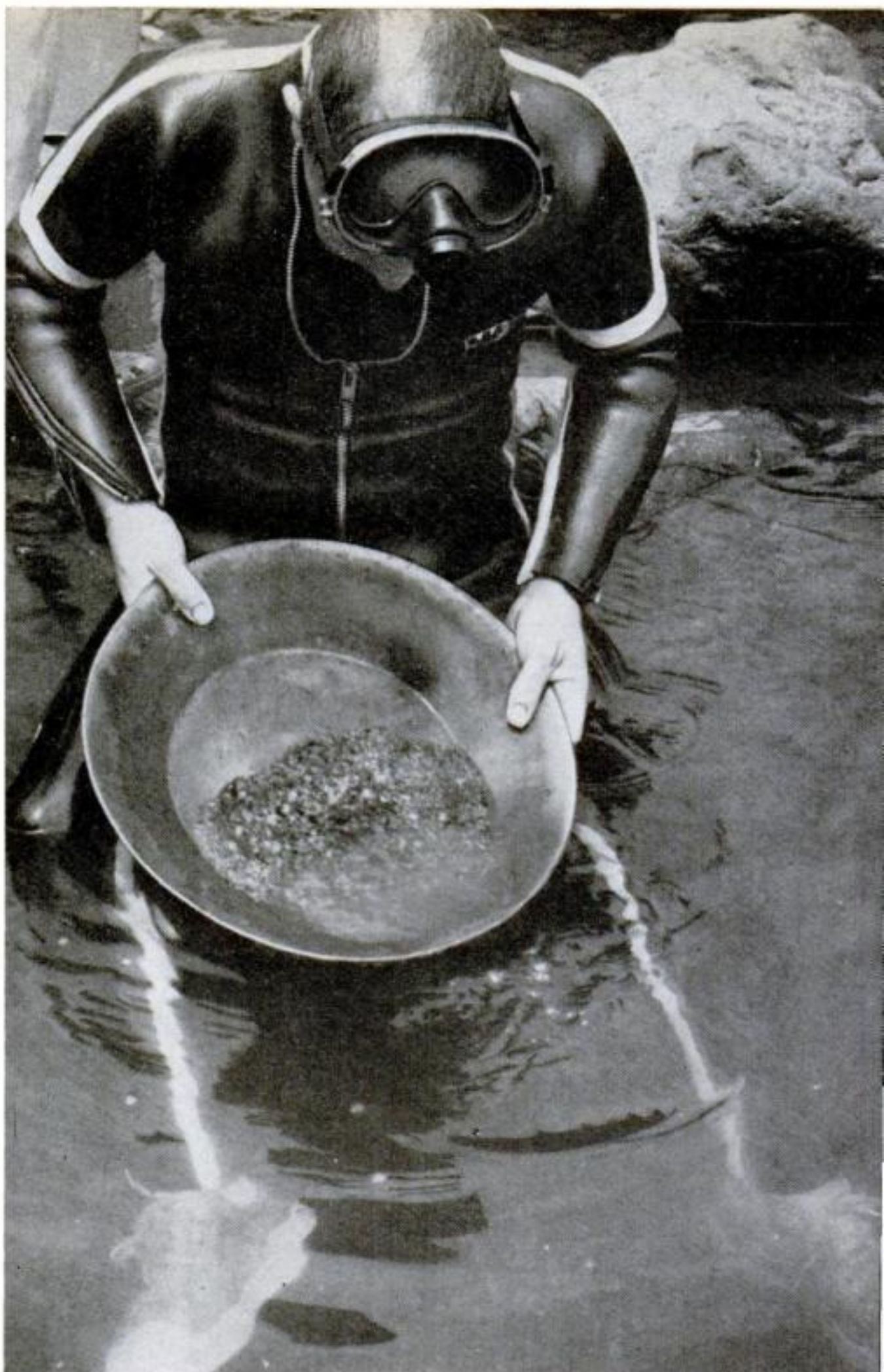
Skin divers in central California's gold country have combined their favorite sport with prospecting. Weekends and holidays you can find them camping near the banks of gold-bearing rivers, working singly or in pairs to separate gold from rocks and sand in the stream beds.

Equipment usually consists of a gasoline engine of about three horsepower, driving an air compressor and small pump mounted on a floating truck-tire inner tube. There's also an underwater sluice box through which sand, gravel, and water are pumped. From time to time, a diver brings up the sluice box, cleans it out on the shore, and dumps its contents into a bucket for later panning.

This is the pay-off. As the diver pans his take, he flips out sand and gravel with a rotating motion, leaving the heavier gold and residue in the bottom.

If he's had luck, he may find as many as 30 bits of gold, some of them nuggets the size of a small pea. When he's rid of the refuse, he caps his yield in a jar, and dives for more.

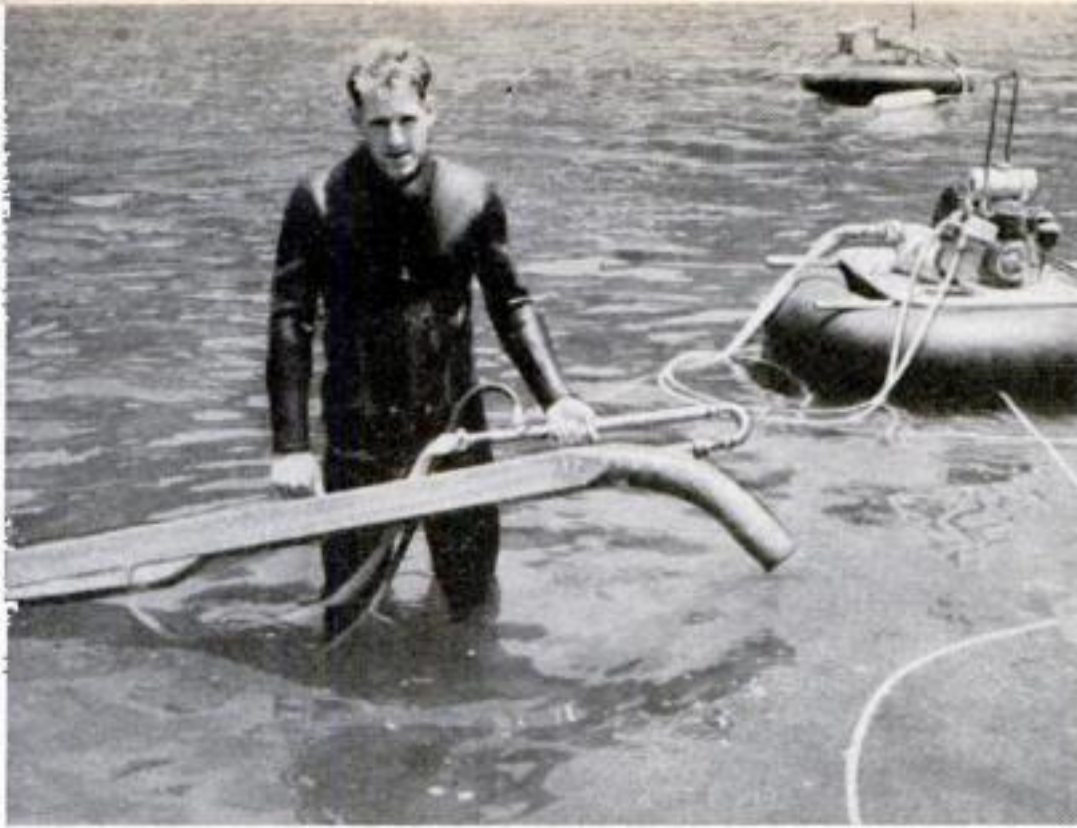
PANNING THE TAKE is last step in gold-hunt skin diving. A lucky diver may get as many as 30 pieces in one panning.



New accelerator works on air

A pneumatic throttle, shown at left both in cutaway and assembled, eliminates the levers, springs, and cables of the usual mechanical linkage in a car.

Developed in England by Dunlop, the system uses trapped air to transmit signals from the driver's foot to the engine. A button on the floorboard is connected by flexible plastic tubing to a diaphragm actuator linked directly to the carburetor.



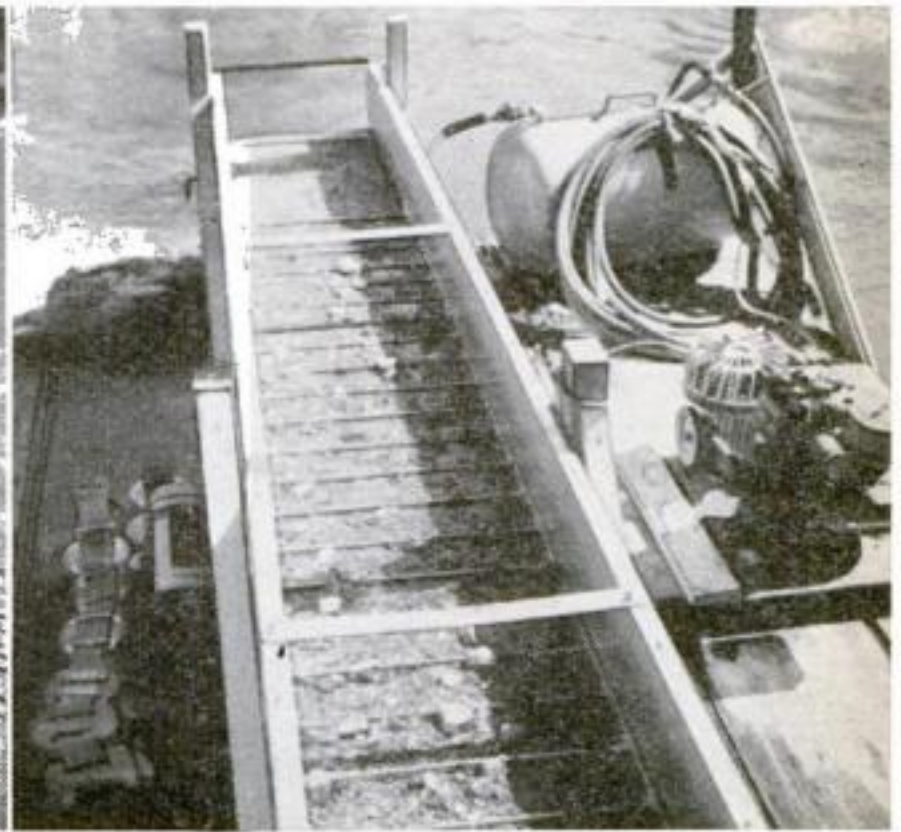
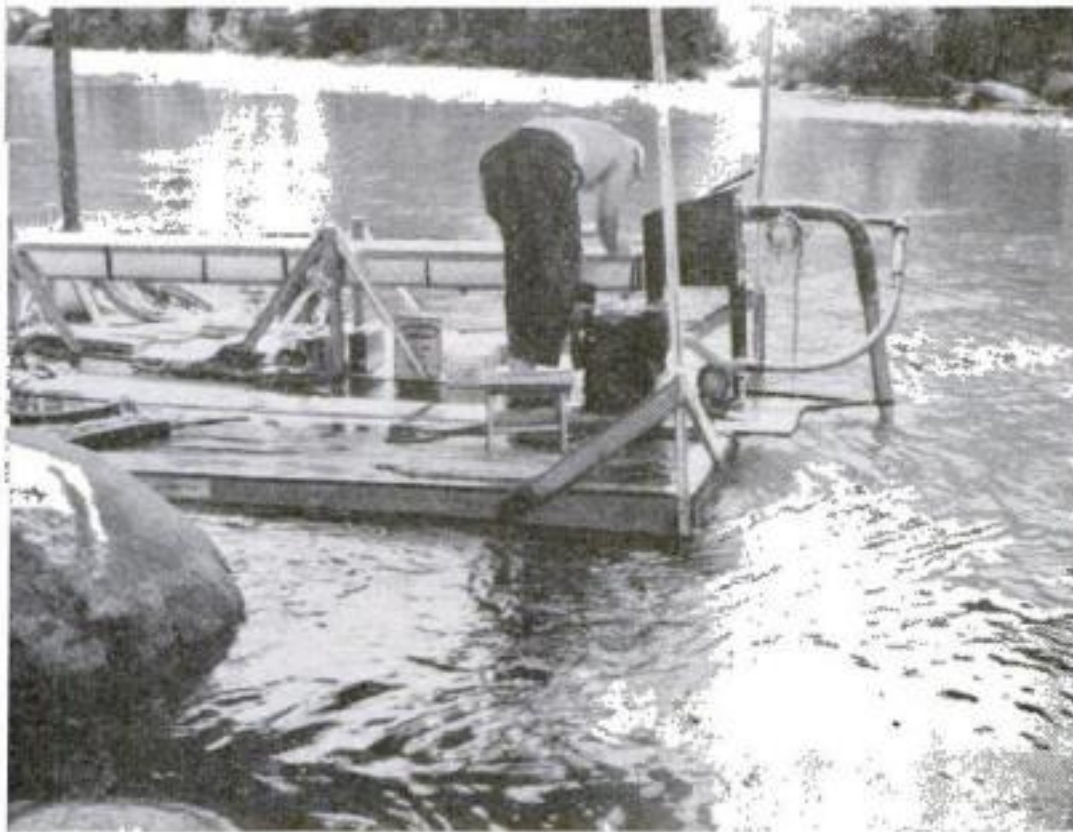
HOMEMADE SHEET-METAL SLUICE BOX looks like ordinary downspout, but has cleated box at exhaust end (left) to trap heavy gold and let most of sand and gravel through. Engine, pump, and compressor float on inner tube.

BIGGER OPERATORS may do sluicing above water, use two skin divers to direct suction hose in bed of stream. This rig, worth \$1,500, is run by four partners on Stanislaus River.



UNDERWATER SLUICE BOX (bottom of photo) is set by skin diver on rocky ledge at bend of stream where channel rushes against wall. Other likely places for gold deposits are deep holes near large sand bars at bends.

LONG SLUICE BOX, open at top, has extra length for greater capacity—and better trapping of large particles. Cleats on bottom, like those in smaller boxes, hold back heavy bits of gold.



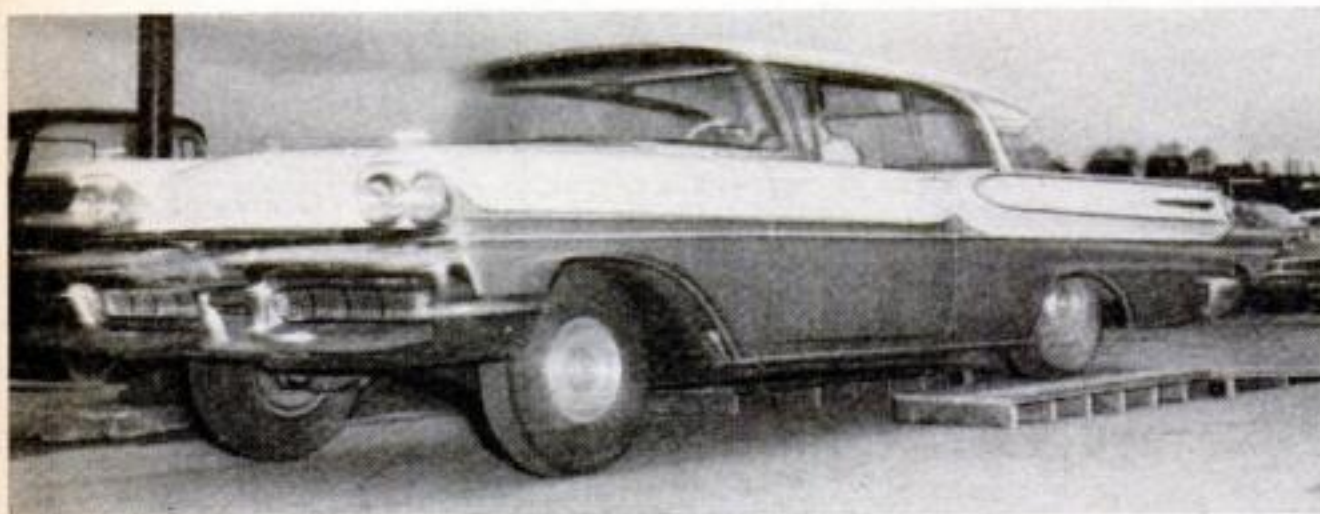
Car telephone leaves hands free

A pivoted boom microphone replaces the conventional handset in the automobile telephone at right. Like other car phones, it operates through telephone-company base stations. A receiver-transmitter is mounted in the trunk and a control head on the dash. A light and a buzzer warn of a call. The driver presses a foot switch near the headlight dimmer to talk, releases it to listen. Called AChieverfone, it's produced by GM's AC Spark Plug Division.



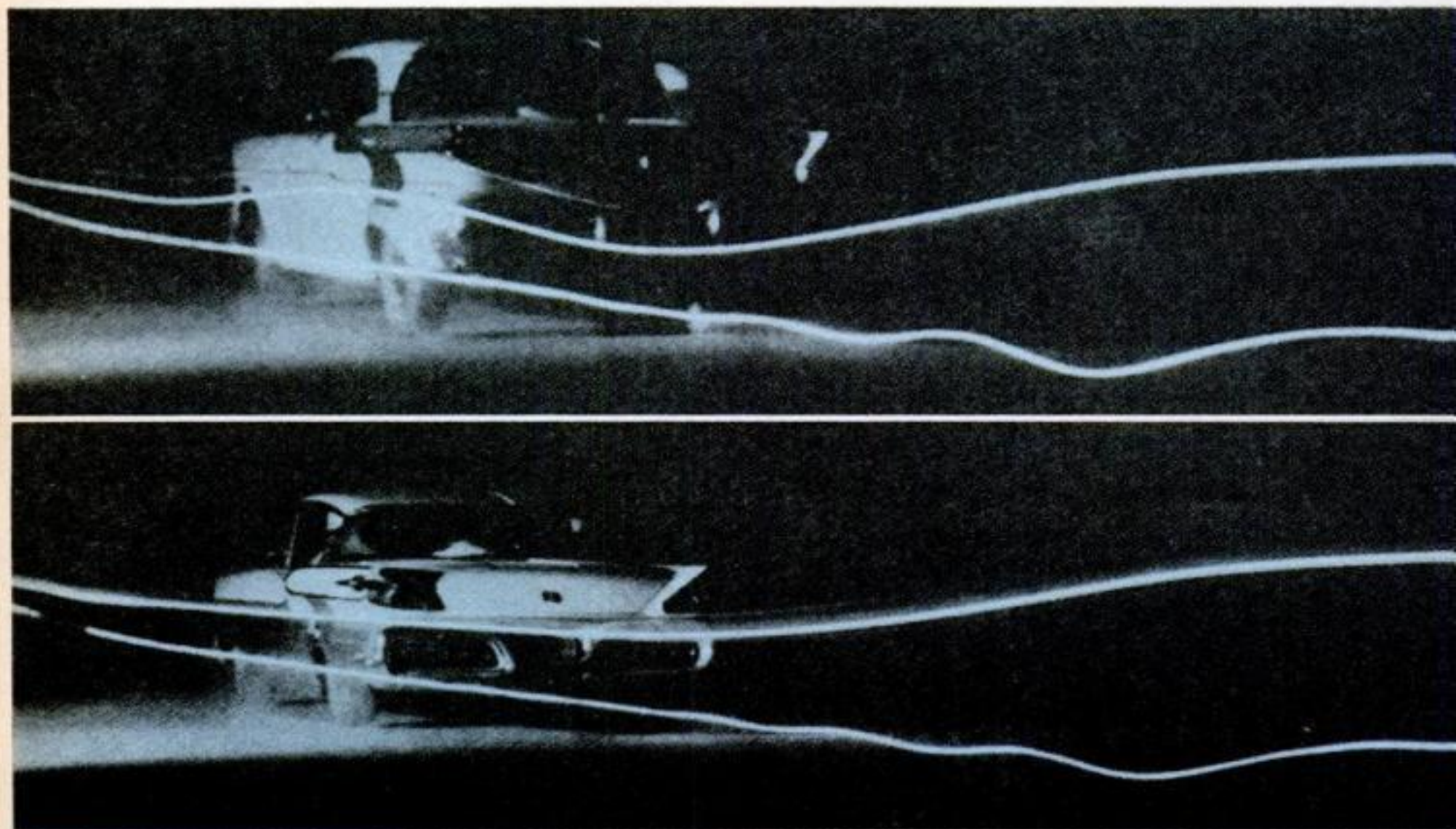


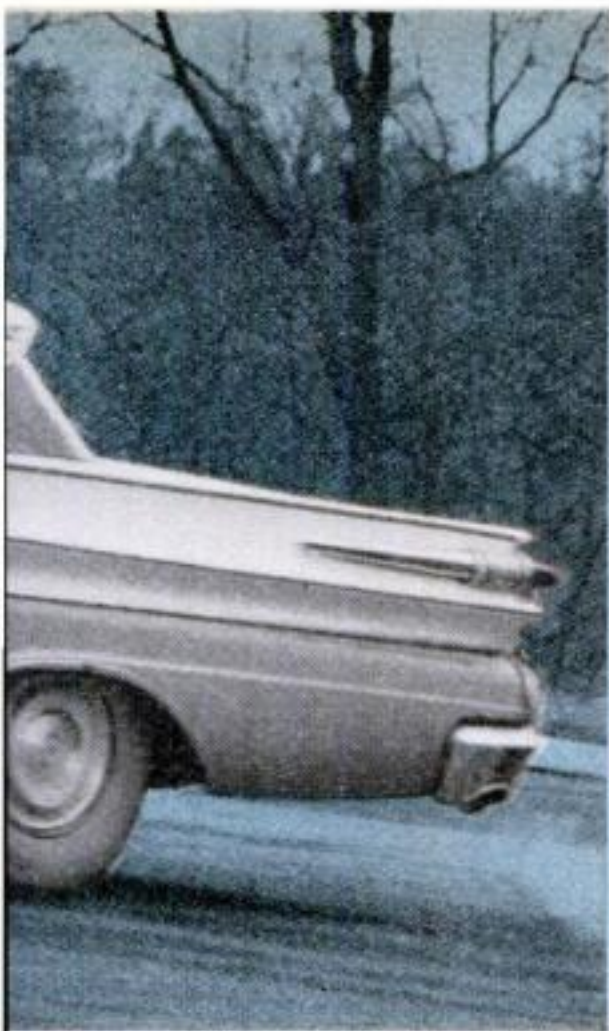
Banking into turn, Westinghouse test car defies inertial forces—disconcerting to the driver



When the road gets rough, wheel and body part company

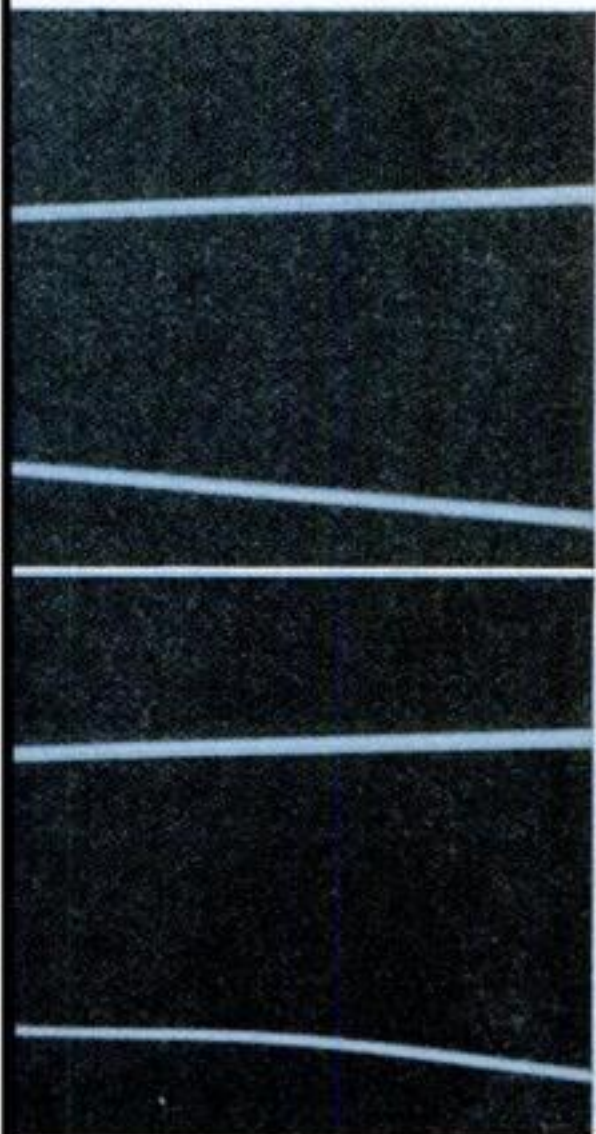
DRIVING OFF A RAMP at 40 m.p.h. produced only a slight jolt (left). The same stunt, using a stock 1957 Merc, almost unglued the author's vertebrae—at 30 m.p.h.





until he gets used to it.

TIME EXPOSURES taken with lights attached above wheel well and on rear wheel disk of stock 1957 Mercury (upper photo, below) and stabilized test car (lower photo) show what happens when cars are driven off ramp. Wheel motion of both cars is practically the same, but the body of the test car oscillated considerably less.



This Car Banks Into Turns Like a Plane

The magic is a new stabilizer that uses engine power. Bonus: It keeps the body level regardless of bumps and potholes

By Alex Markovich

ANYONE who knows a drive shaft from a dachshund can tell you that a car tends to roll, or lean out, on a curve. But the news release on my desk claimed—with no trace of tongue in cheek—that Westinghouse had developed a car that banks *into* turns, like an airplane. There was some stuff about an “active” hydraulic suspension that uses power from the car engine to stabilize the body, no matter what the motion of the wheels.

To further strain my credulity, the release stated that the system offers superior handling as well as extremely soft ride. Both. Together.

I took the offending release to the editor. He raised his eyebrows in disbelief.

Next morning I found myself on a plane bound for Pittsburgh and the Westinghouse Research Laboratories.

There I was greeted by W. O. Osbon, a section manager in the electromechanics department and director of the suspension project.

“Does your car really bank into turns?” I asked. I felt as if I were inquiring whether there really was a Santa Claus. Osbon pulled a blueprint from his desk and handed it to me.

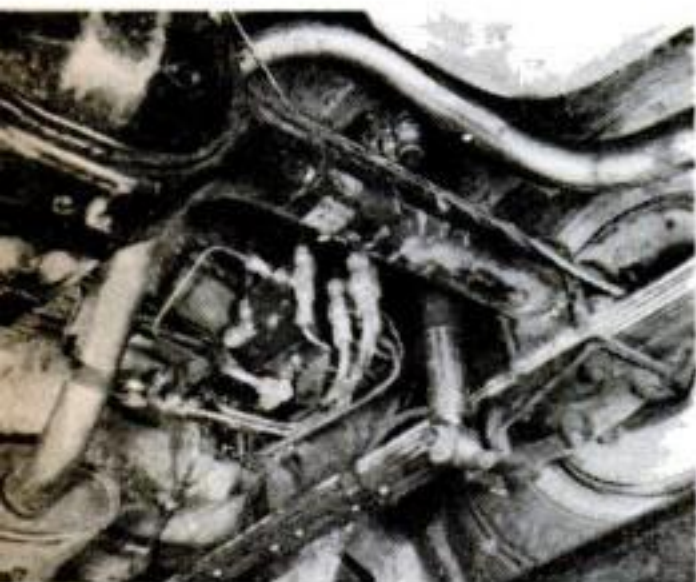
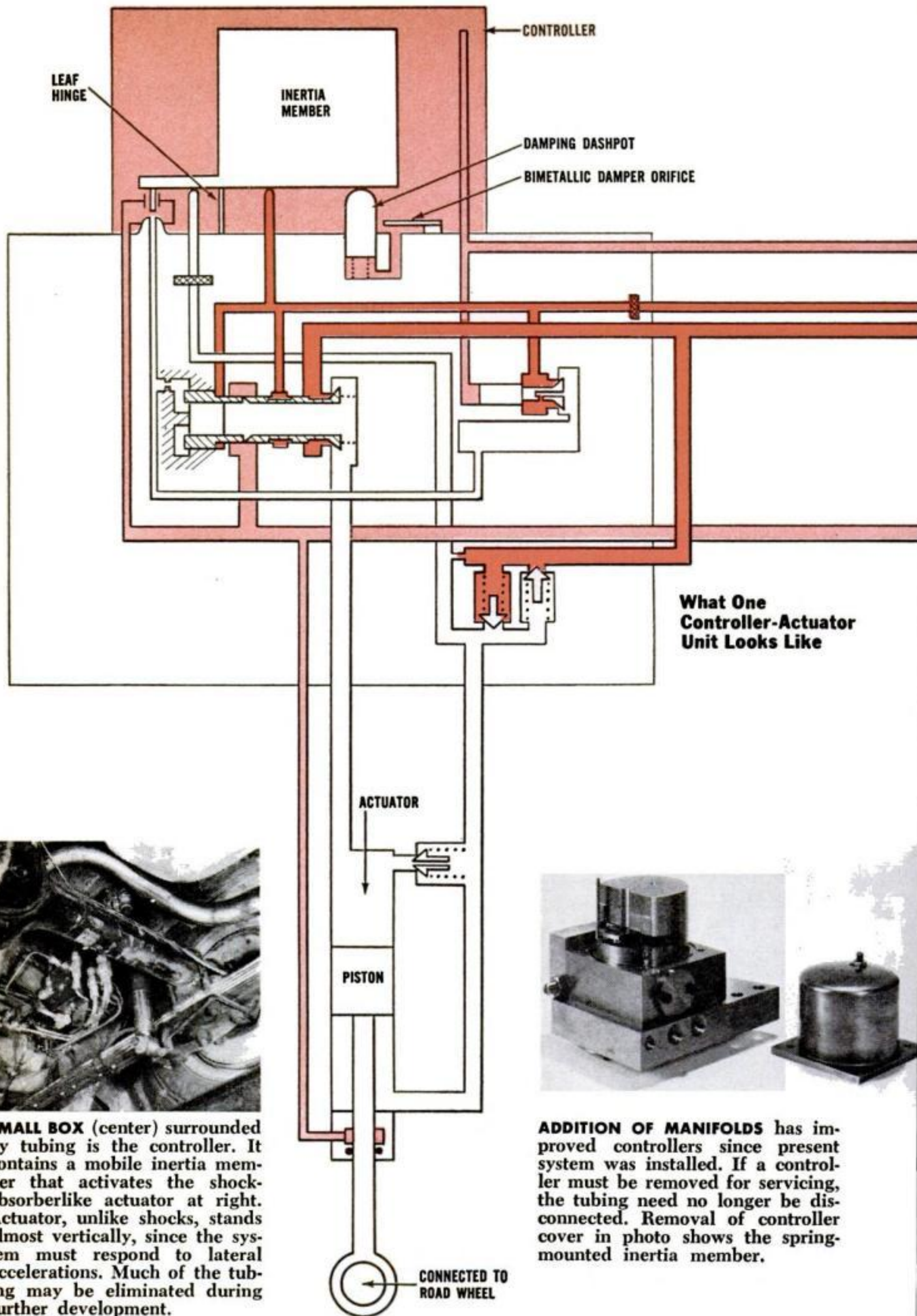
“First let me explain how our suspension works,” he said. “Then you can drive the car and see for yourself.”

Ordinary springs and shock absorbers, he reminded me, are passive. All they can do is damp out some of the body motion initiated by the wheels. But when the Westinghouse-stabilized car goes over a pothole, the wheel is forced down hydraulically. The body tends to remain level. On a bump, the opposite happens: The wheel is lifted in the direction in which it must move anyway. The wheels no longer react passively to road ir-

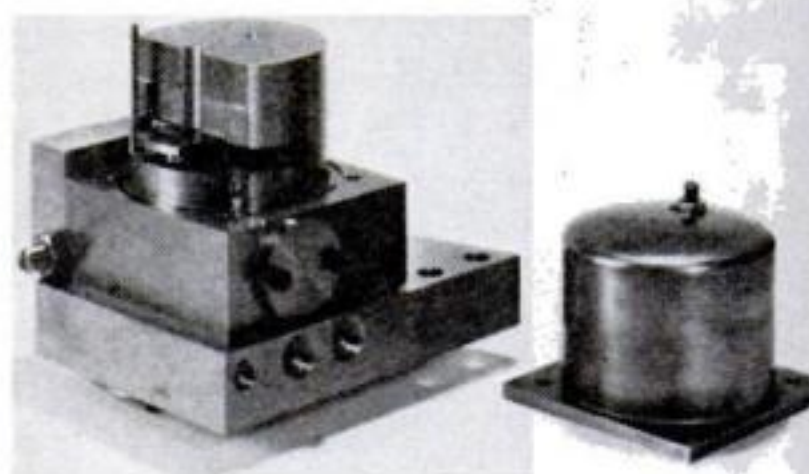


BOUNCING THE ENDS of the test car was practically impossible, as the author found out. The powered suspension felt harder than that of the notoriously stiff-riding Morgan sports car.

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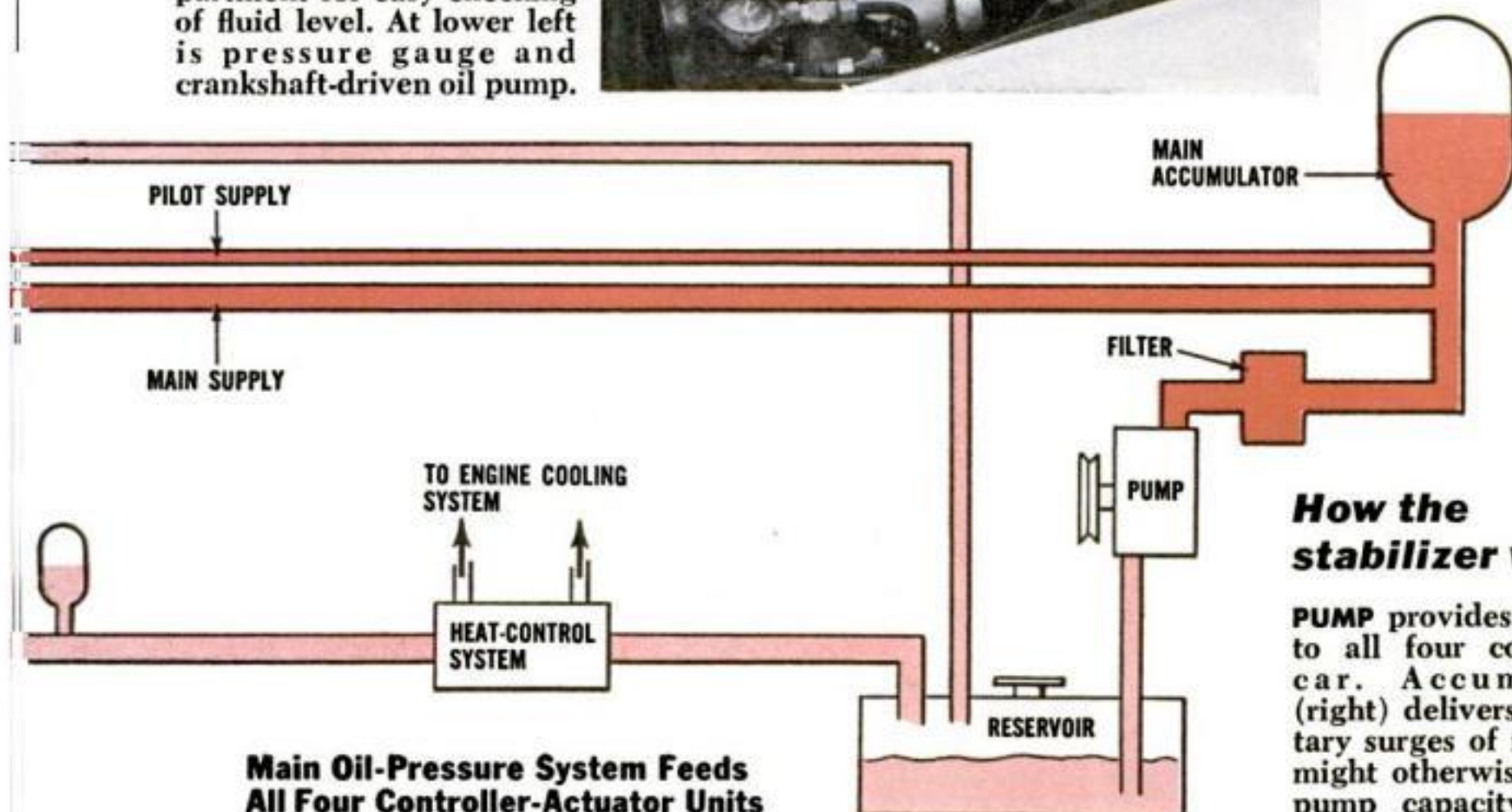


SMALL BOX (center) surrounded by tubing is the controller. It contains a mobile inertia member that activates the shock-absorberlike actuator at right. Actuator, unlike shocks, stands almost vertically, since the system must respond to lateral accelerations. Much of the tubing may be eliminated during further development.



ADDITION OF MANIFOLDS has improved controllers since present system was installed. If a controller must be removed for servicing, the tubing need no longer be disconnected. Removal of controller cover in photo shows the spring-mounted inertia member.

OIL RESERVOIR (lower right), filled with automatic-transmission fluid, perches high in the engine compartment for easy checking of fluid level. At lower left is pressure gauge and crankshaft-driven oil pump.



Main Oil-Pressure System Feeds All Four Controller-Actuator Units

How the stabilizer works

PUMP provides pressure to all four corners of car. **Accumulator** (right) delivers momentary surges of fluid that might otherwise exceed pump capacity. Piston area of actuator (bottom left) is twice that of rod area. Thus average pressure in lower cylinder is twice that of upper cylinder, and equal to the supply pressure of 1,500 p.s.i. Only the upper-cylinder pressure is varied for ride control, simplifying the system. Two-pound inertia member pivots on frictionless leaf hinge and is damped by a dashpot underneath. Bimetallic damper orifice controls dashpot resistance thermostatically, insuring constant damping even under extreme temperature changes.

regularities. They are raised and lowered under power.

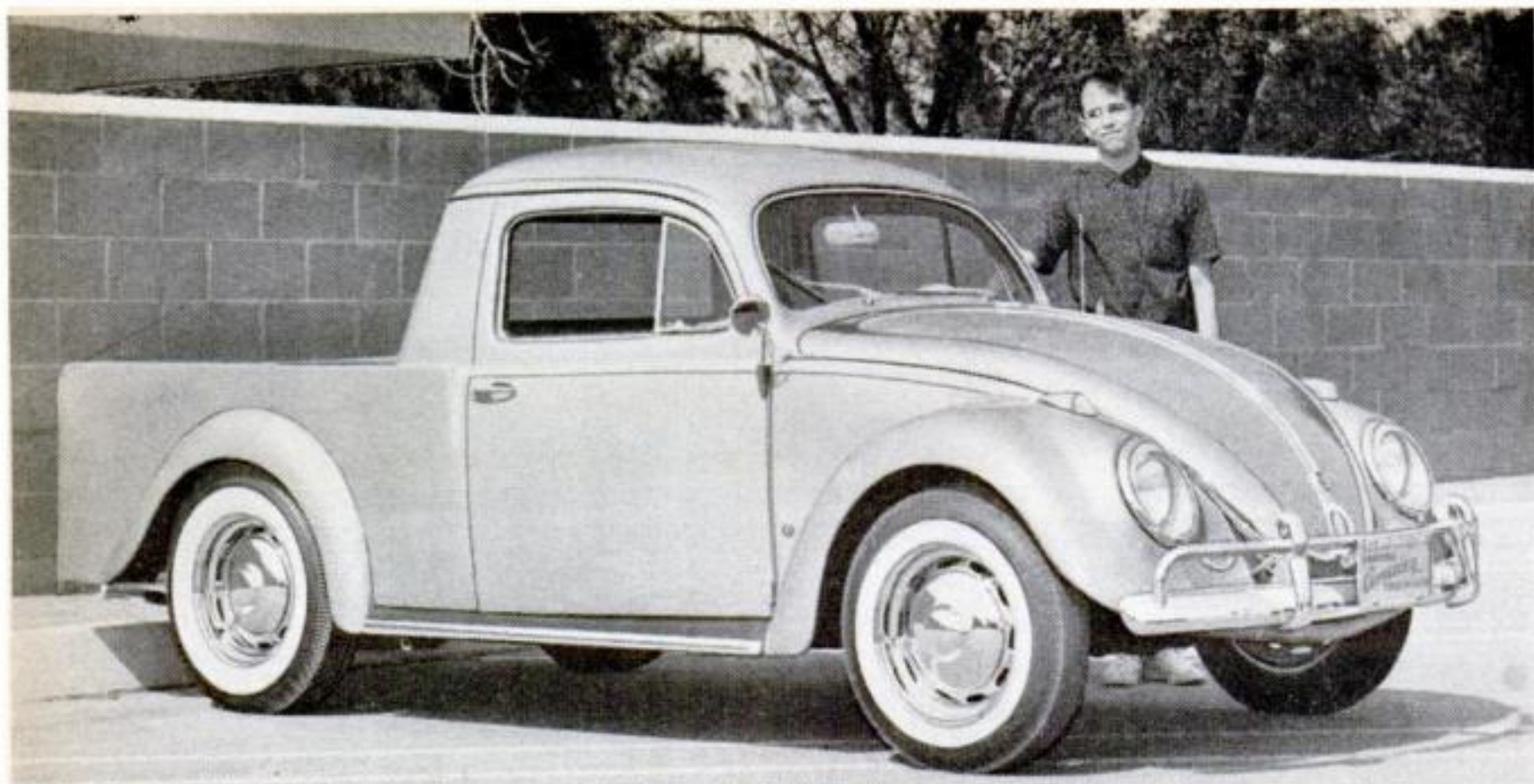
The control valves. In the maze of oil lines and other spaghetti on the blueprint, Osbon pointed out four controllers, one at each corner of the car. Each controller, he explained, contains a two-pound weight, or inertia member, set on a spring. When the rate of the car's vertical motion changes or when the car's body tends to stray from a level position—because of road irregularities, rolling out on curves, nose-diving during braking, or leaning on high-crowned roads—the weight pivots. As it does so, it opens or closes valves that control oil pressure in a hydraulic actuator.

The system has four actuators, also one in each corner, in place of shock absorbers. Within each actuator is a piston connected to a road wheel. If pressure drops, the piston goes up and lifts the wheel. If pressure rises, the piston is forced down along with the wheel. The oil pressure for all four corners is provided by a single hydraulic pump driven by the car engine.

Each two-pound inertia member generates the equivalent of about 4,000 pounds of weight at its actuator. Thus a synthetic mass about four times greater than the mass of the car is created, giving the same effect as if the car's weight were increased by a factor of five. In other words, the "bounce" frequency of the body on the car's stock springs is the same as if the springs were made five times softer.

When a conventionally suspended car corners, centrifugal force tends to lift the inside wheels and throw most of the car's weight onto the outside wheels. A sway bar reduces roll

[Continued on page 194]



"Beetlebomb" pickup

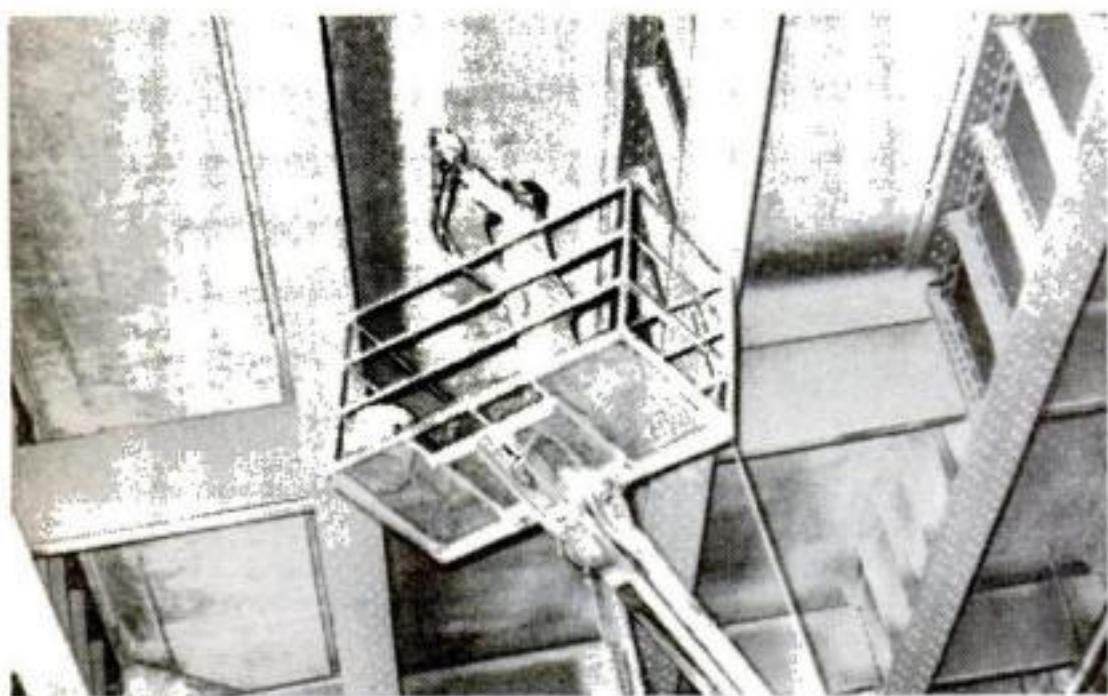
From the front it's just another of those ubiquitous German "beetles." But one peek aft, and you'll think the elves of the Black Forest had a field day.

The high jinks started when Joe Vitone of Riverside, Calif., and his son Darrell (in photo above) got tired of their '55 Volkswagen sedan looking just like its 600,000 brothers. With the help of a body shop, they cut away the rear of the passenger compartment and molded a handmade pickup bed in its place. Wheels are Porsche; shocks, Gabriel in front, Koni at rear. Tiny aluminum flakes in the lacquer give a dazzling finish.

The mild-mannered power plant was bored and stroked, and now boasts a ported and polished 9:1-compression-ratio head, high-lift camshaft, and Paxton supercharger. With an alcohol-fuel mixture, its output tops 80 hp., more than double the stock figure.



RECESSES IN SIDES of pickup bed hold tools and battery. They, as well as the rear engine, will be hidden from view by chromed covers. The tail lights came off a VW bus.



Insulating a bridge against freezing

Illinois tollway authorities insulated the underside of the bridge at left to prevent formation of ice on its surface earlier than on its approach road. An inch thickness of a new urethane compound was applied with a blowgun. It is said to be the equivalent of from two to five feet of earth beneath the surface of the pavement on the approach.



Inoculation by hydraulic pressure

A hydraulic gun fires immunization shots into the arms of Navy patients without needle or syringe.

A jet of vaccine .0051 inch in diameter (about a hair and a third) is driven into the skin by 16,000 pounds of pressure. It travels 150 feet a second faster than a pistol bullet, but feels to the patient like a tap with a finger.

Under test by the Navy for eight years, the instrument has been used to control a yellow-fever epidemic in the Sudan, giving 108,000 injections in 75 days, a feat that would have taken years by other methods. The gun cost \$2,000, is made by R. P. Scherer Corp., Detroit.



Monkey in a squirrel cage

Running about and playing in a slowly rotating hollow plastic globe is fun for this monkey. It's also an aid to scientific and medical research.

Exposed first to slight radiation, such as might be encountered in space or in nuclear warfare, the monkey exercises under the watchful eye of a researcher at the University of Tennessee Medical Units in Memphis. Its reaction at various fatigue levels also helps in evaluating new antifatigue pharmaceuticals.



Sports-car racing in the Soviet

Unmuffled, crackling exhausts sounded in the heart of Moscow recently as Russian motor racing showed signs of coming of age. Crude, fenderless specials were freely mixed with standard production

models. But entries were divided according to displacement of their modified stock engines, with large Zims and Volgas in one class, tiny Moskvitches in another. The course snaked around Lenin Stadium, a swimming pool, and a smaller stadium in Luzhniki Sports Park.

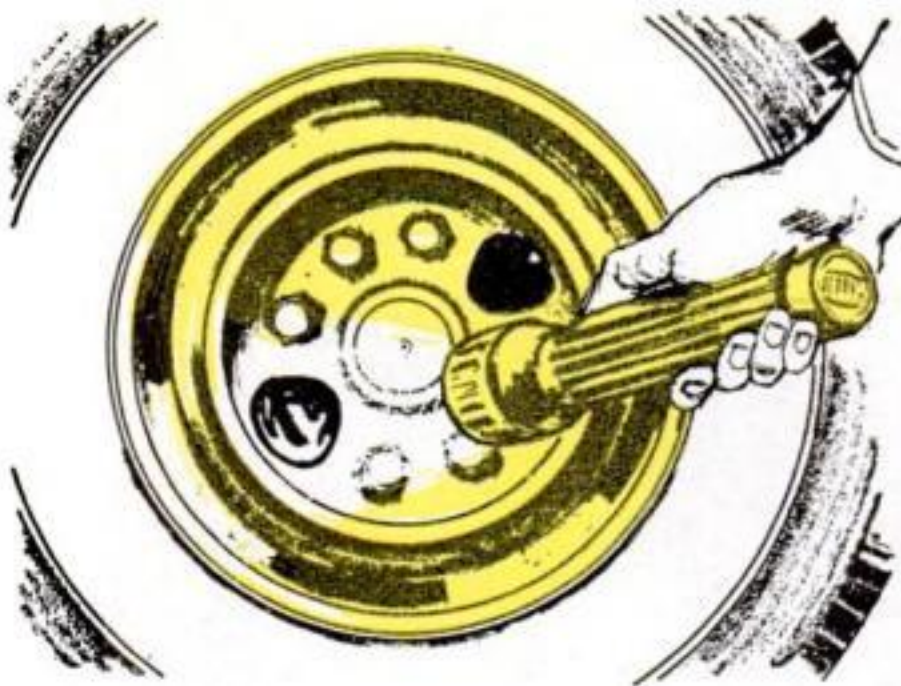
"I'd like to see them make..."



PULL-OUT HOSES on bathtubs, like those on kitchen sinks. They'd be fine for rinsing out the tub or for bathing and shampooing youngsters. —Mrs. G. K. Williamson, Bedford, Ind.



PICK-UP SHEETS OF METAL FOIL in boxes. With a choice of small, medium, or large sheets, there would be less waste than with one-size rolls. —Leon Holub, Island Park, N.Y.



BRAKE-INSPECTION PORTS on car and truck wheels. Removing the hubcap would expose the port in the brake drum for checking lining wear. —R. E. Baker, W. Lafayette, Ind.



MADE-FOR-THE-JOB FUNNELS to fit wide-mouth and regular vacuum bottles. They'd also have large enough bottom openings to handle thick soups. —Mrs. Alex Mitin, Bay Port, Mich.



TWO-FACED RULERS marked on one face with measurements from the midpoint outward. They'd make it easy to determine the center between points. —R. E. Solfest, Eau Claire, Wis.

Everyone has his own pet idea of a gadget that he would like to see in general use. What's yours? We will pay \$5 for each one published. Please use Government postcards

only. Send to ILTS Editor, Popular Science, 355 Lexington Ave., NYC 17. Write your name and address clearly. Contributions cannot be acknowledged or returned.



Sod and goal posts turn meeting hall into gridiron

The 360-foot-long Convention Hall in Atlantic City, N.J., was converted last winter into a football stadium for a game between local high-school teams. The floor was covered with four inches of sod, and goal posts were erected

against the stage seen in right background and in front of seats in left foreground. The arena's 300-foot width allowed space for stands along the side lines; a 137-foot roof height—equal to 13 stories—gave players punting space.

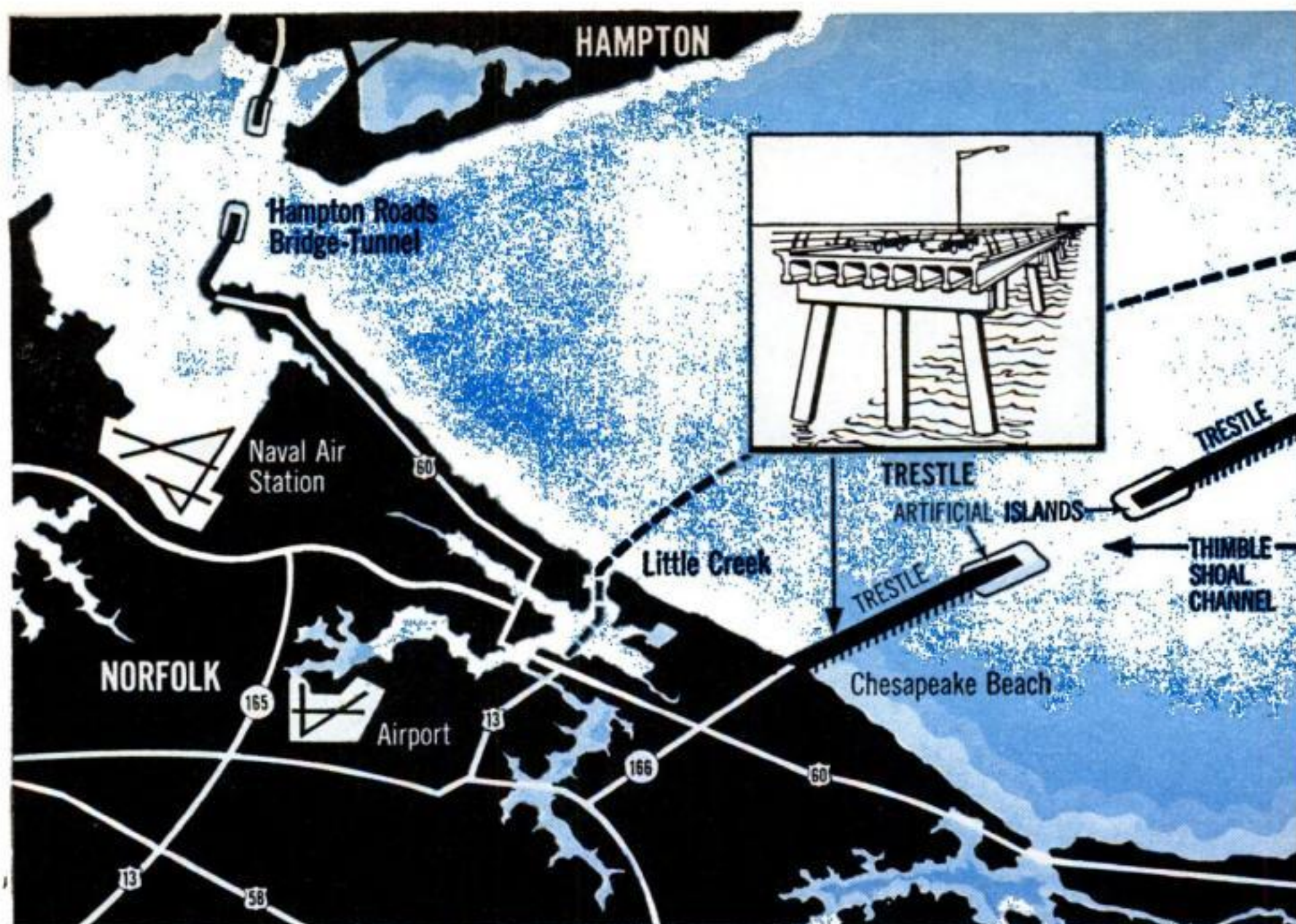


Lift bridge for island traffic

The new \$4,000,000 Kingsferry lift bridge provides the only highway and rail link between the Isle of Sheppey off the mouth of the Thames and the British mainland in Kent. Its 90-foot-

long, 465-ton lift span is raised by motors in a minute and a half to the top of four towers 95 feet above high tide.

The 650-foot bridge replaces an older one that has now been demolished. It carries railroad tracks, automobile roadways, and a pedestrian path.

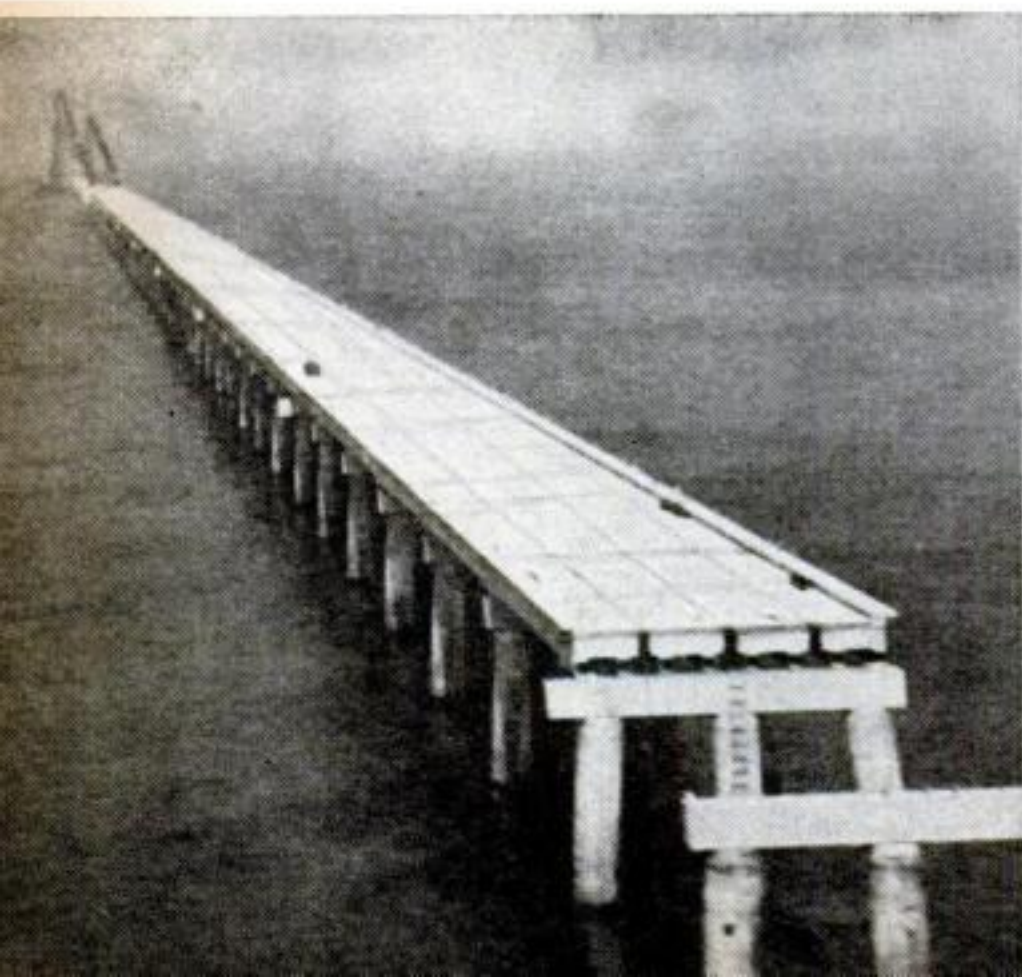


Chesapeake Bay Bridge-Tunnel, world's longest, will be combination of trestle, undersea tubes,

17-Mile Highway Crosses

***PS takes you to see an engineering wonder in the making—
from air, water, and the decks of monster seagoing machines***

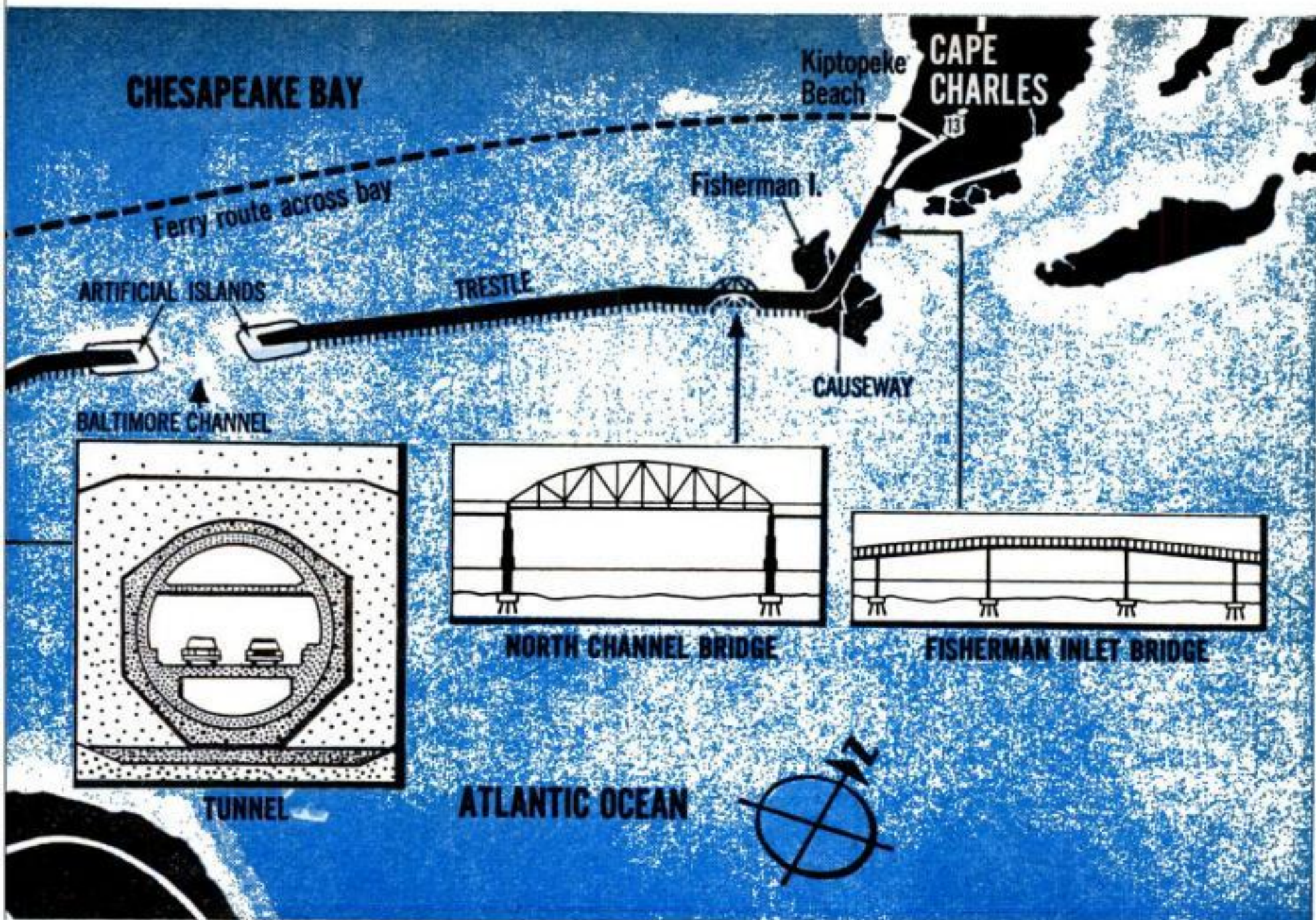
By Alden P. Armagnac, with photos by W. W. Morris



THREE gigantic machines, 150 to 180 feet long, are striding, rolling, and swinging themselves across the mouth of Chesapeake Bay. In assembly-line fashion, they're building a highway over virtually open sea.

Where the strange procession has passed, a concrete trestle with a two-lane roadway now rises 30 feet above the waves. It will form the major part, 12 miles, of the 17.6-mile Chesapeake Bay Bridge-Tunnel—an engineering won-

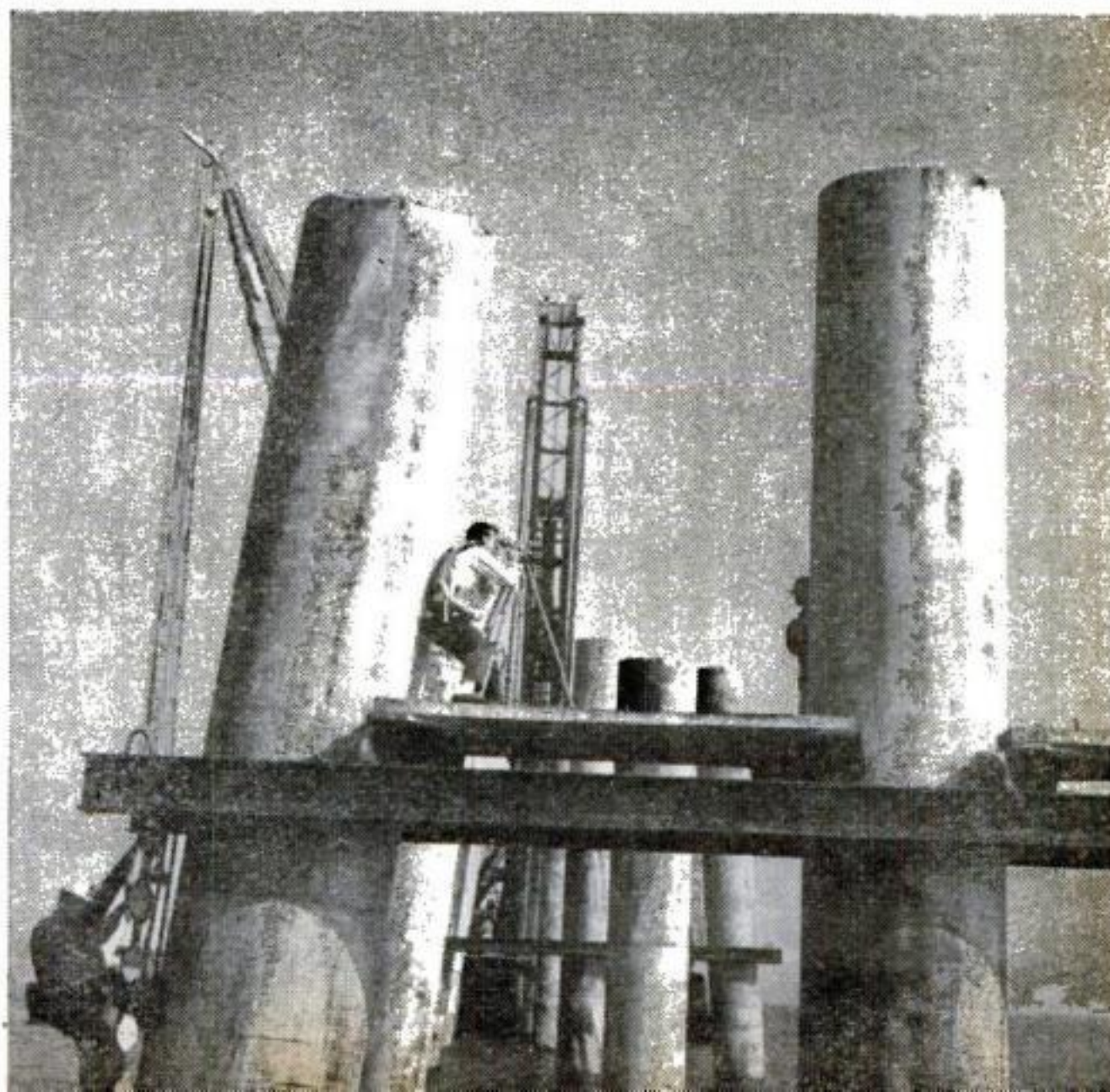
CONCRETE TRESTLE, glimpsed from plane, is being erected by seagoing machines advancing in distance. Starting point just off-shore left gap that will be closed later.



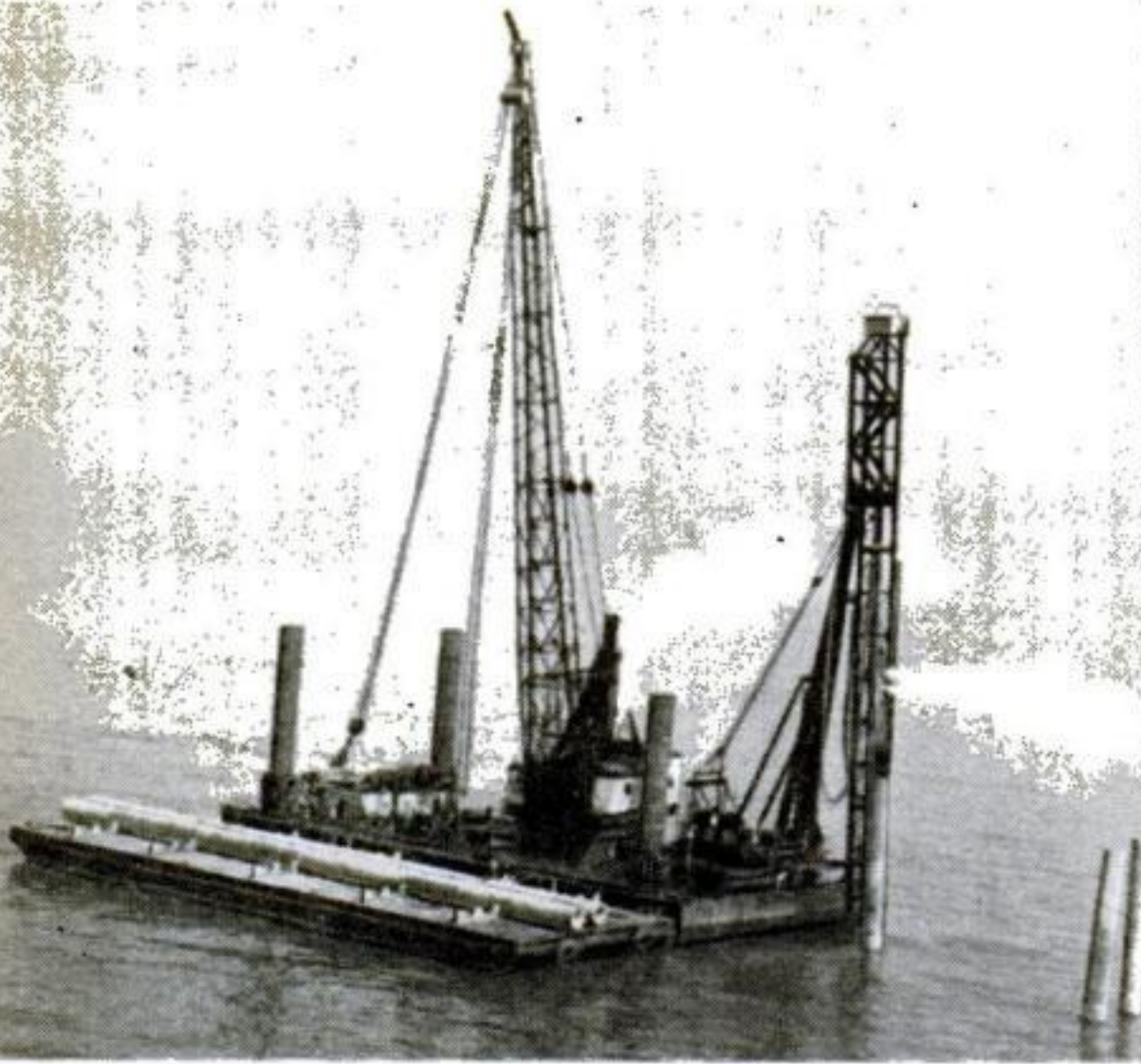
high spans. It dwarfs three-mile Hampton Roads Bridge-Tunnel (upper left) completed in 1957.

Over and Under the Sea

GIANT PILES of concrete for trestle measure 54 inches in diameter and up to 160 feet in length. Every 75 feet, a row of three piles will support ends of adjacent spans of trestle. After hollow pile is driven (by machine in background), a filling of sand buttresses its five-inch-thick wall against impact of colliding boat or ice floe. In photo, surveyor checks alignment of advancing trestle, to assure placing each pile with required accuracy: no more than three inches in any direction from prescribed location.



The Big D, a great



DRIVING TRESTLE'S PILES is job of Big D, shown with pile-delivering barge moored at its side. Although piledriver's oblong 70-by-150-foot hull appears to be floating, it actually stands on four legs that extend to bottom, bracing it against waves.



TO DRIVE A PILE: Big D's mighty crane, with 185-foot boom, lifts pile from barge. This pile is a huge 160-footer.

der so bold in scale as to dwarf anything else of its kind in the world.

Due to be opened to motorists late next year, the spectacular bay crossing will bring New York and Florida 1½ hours nearer each other. Replacing the ferries that ply between Cape Charles and the Norfolk area, it will eliminate the last water barrier of the East Coast's scenic, sea-level, traffic-bypassing Ocean Hiway.

During the 25-minute ride across the bay's mouth, the trestle will carry a motorist clear out of sight of land. Before he reaches the far shore, he'll dive under two major ship channels, in mile-long vehicular tubes—and soar over two minor ones on high steel bridges. He'll

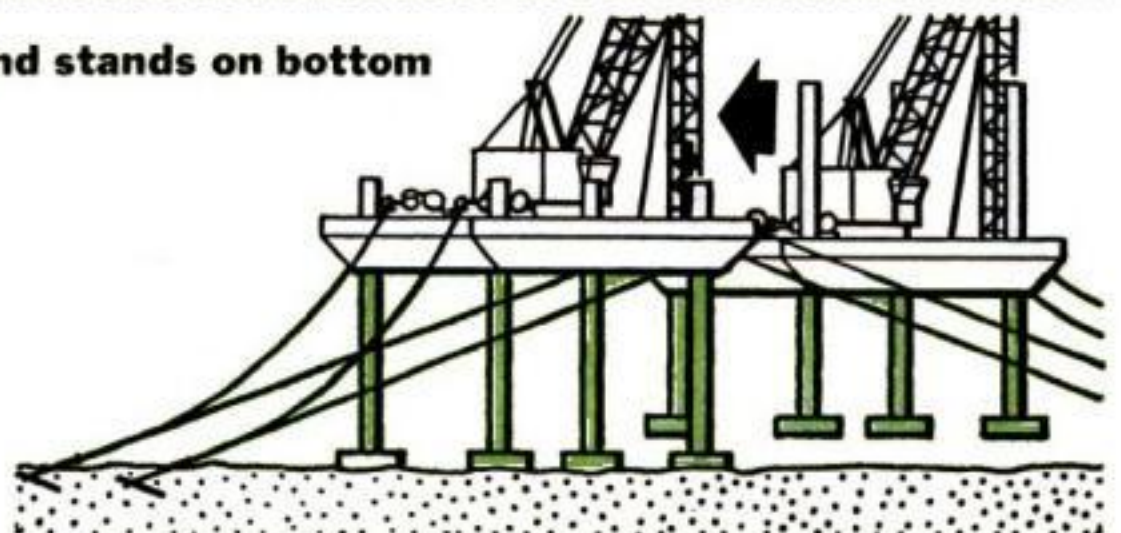
cross four man-made islands where the sea highway turns from a bridge into a tunnel, and back again.

Sponsored by Virginia's Chesapeake Bay Bridge and Tunnel Commission, the \$139,000,000 project has brought together the greatest array of equipment ever assembled for a marine construction job. By boat and plane and aboard the seagoing machines, PS photographer Bill Morris and this writer recently watched it in action. Most eye-filling of all are the mechanical monsters unreeling a white ribbon of trestle across sea-green water up to 50 feet deep.

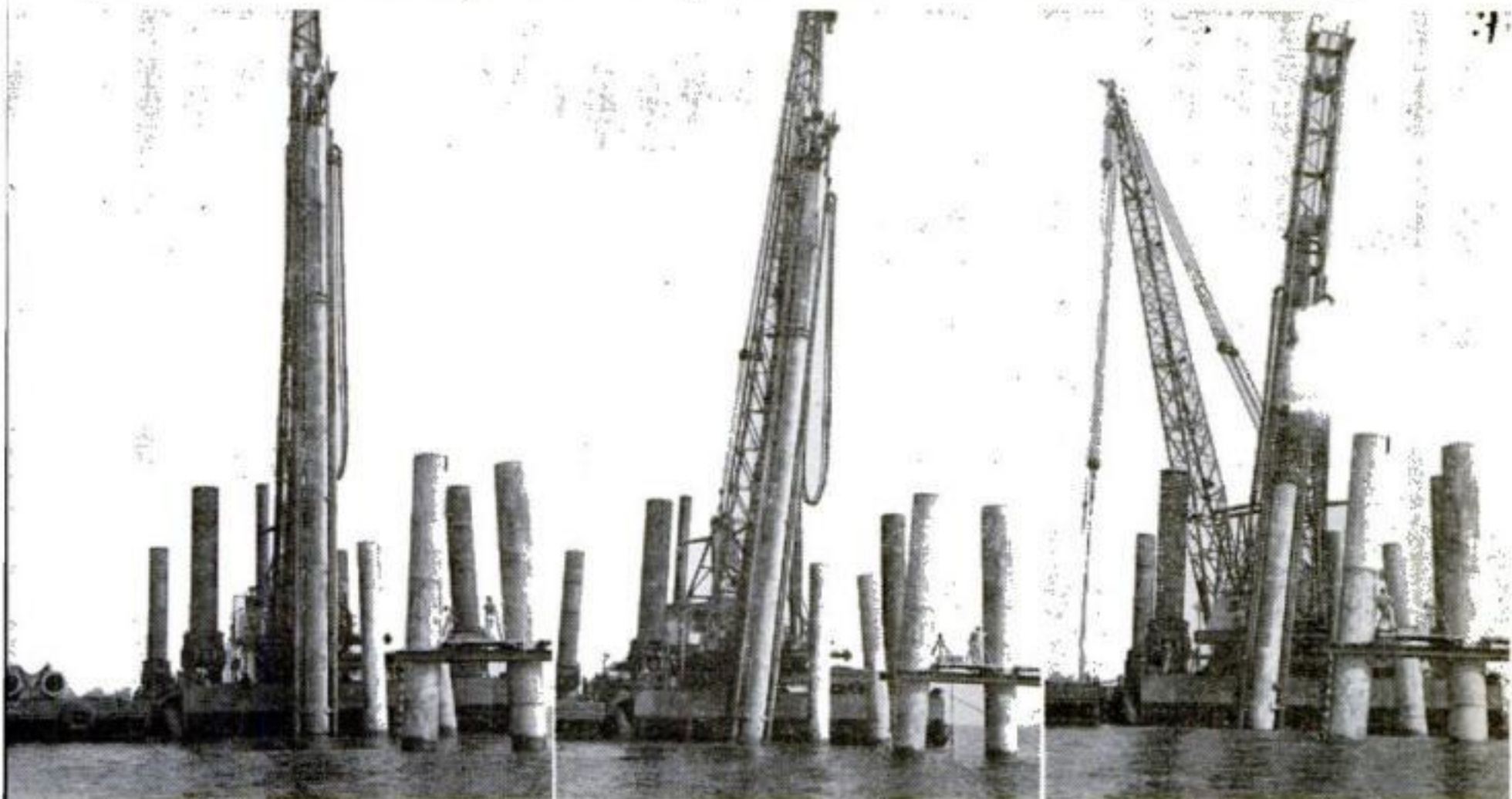
Leading the way, the Big D—"D" for Driver—is sinking the 2,500 offshore piles that support the trestle. Next

How Big D propels itself ahead—and stands on bottom

To advance, piledriver lifts retractable legs (right). Steam winches pull floating hull ahead by anchor cables. Then 100-foot-long legs go down to bottom again (left), raising hull part way from water and steadying it. They'll even lift hull clear of water, and wave battering, in bad storms. So legs won't sink into bottom, 28-foot-diameter pontoons serve as feet.



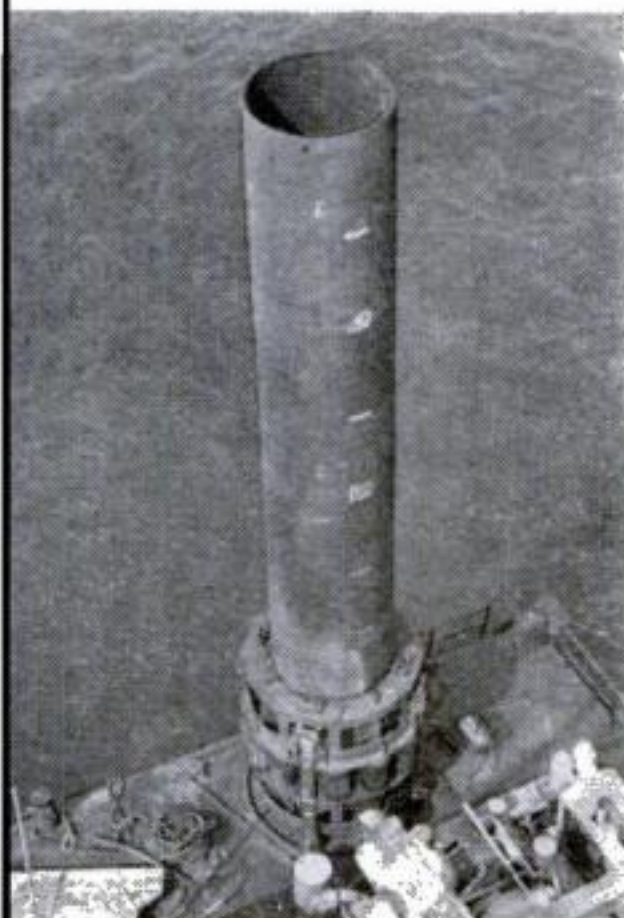
piledriver on stilts, leads the procession that builds the trestle



UP-ENDED PILE is swung into a guiding cradle for driving. It will be the last pile—an outer one—of a row of three.

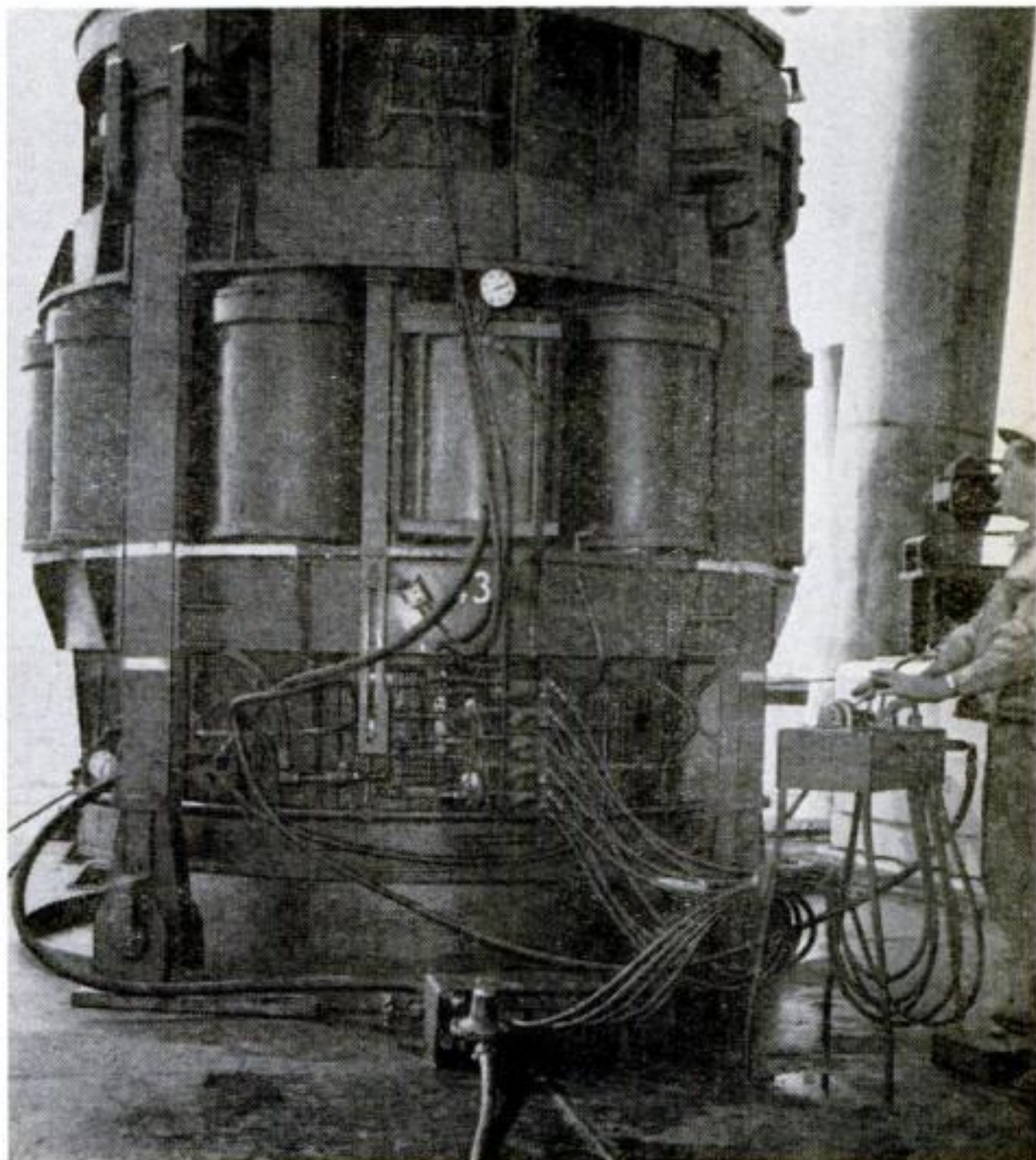
GUIDING CRADLE, pivoted at top, swings at bottom to tilt pile to 1-in-12 slant required for the outer one of a row.

STEAM HAMMER pounds pile home—after water jets give it a start by helping it sink of own weight into soft bottom.



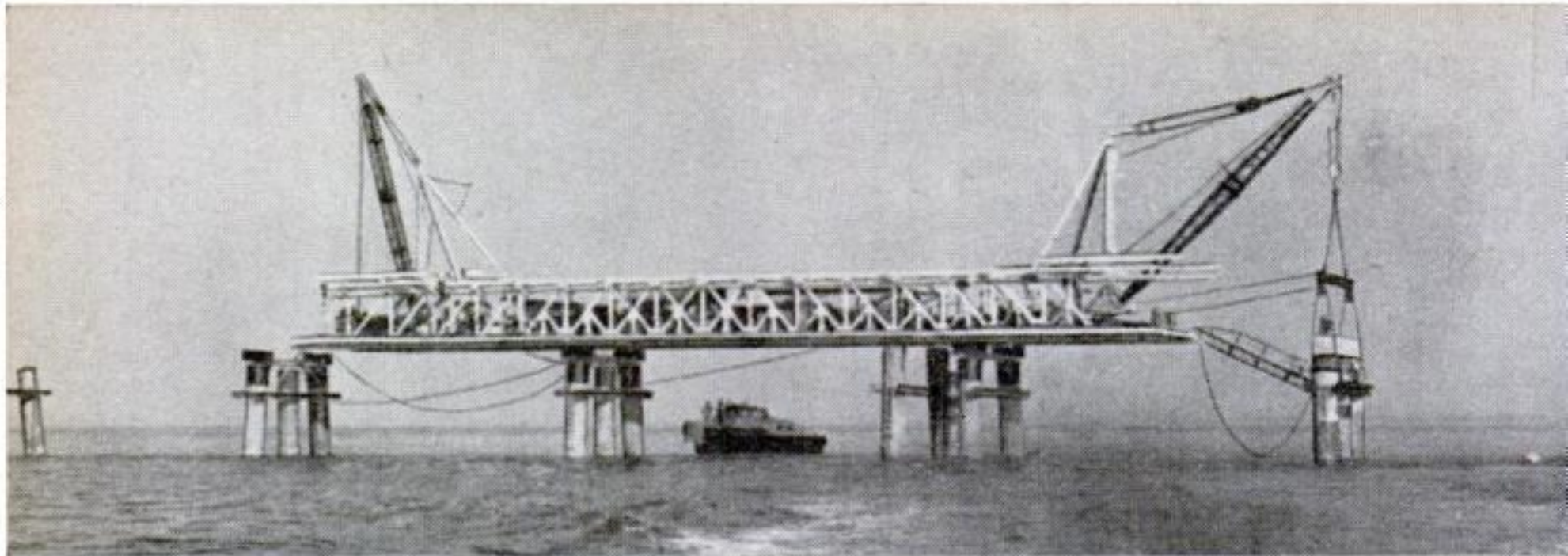
TUBELIKE LEG of steel, six feet in diameter, is viewed from above—with help of Big D's crane, which hoisted PS camera-man aloft for a picture.

COMPRESSED-AIR JACKS around extensible sleeve raise or lower a leg, in inchworm fashion. Top and bottom of sleeve alternately grip the leg.



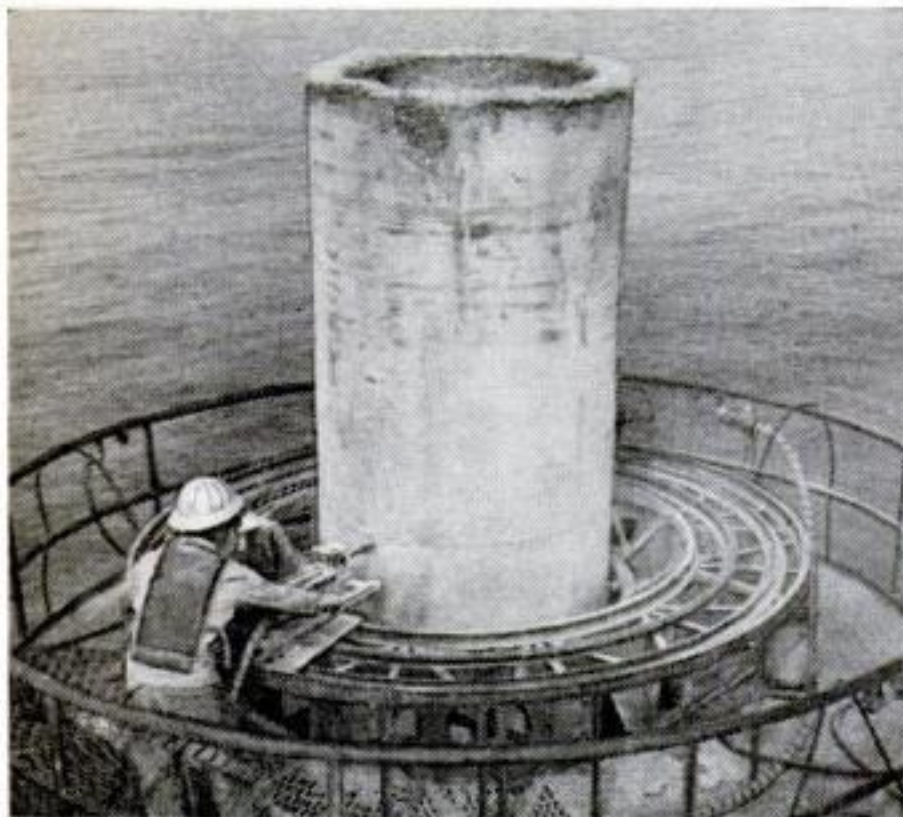
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The Two-Headed Monster, rolling on piles' tops, comes next

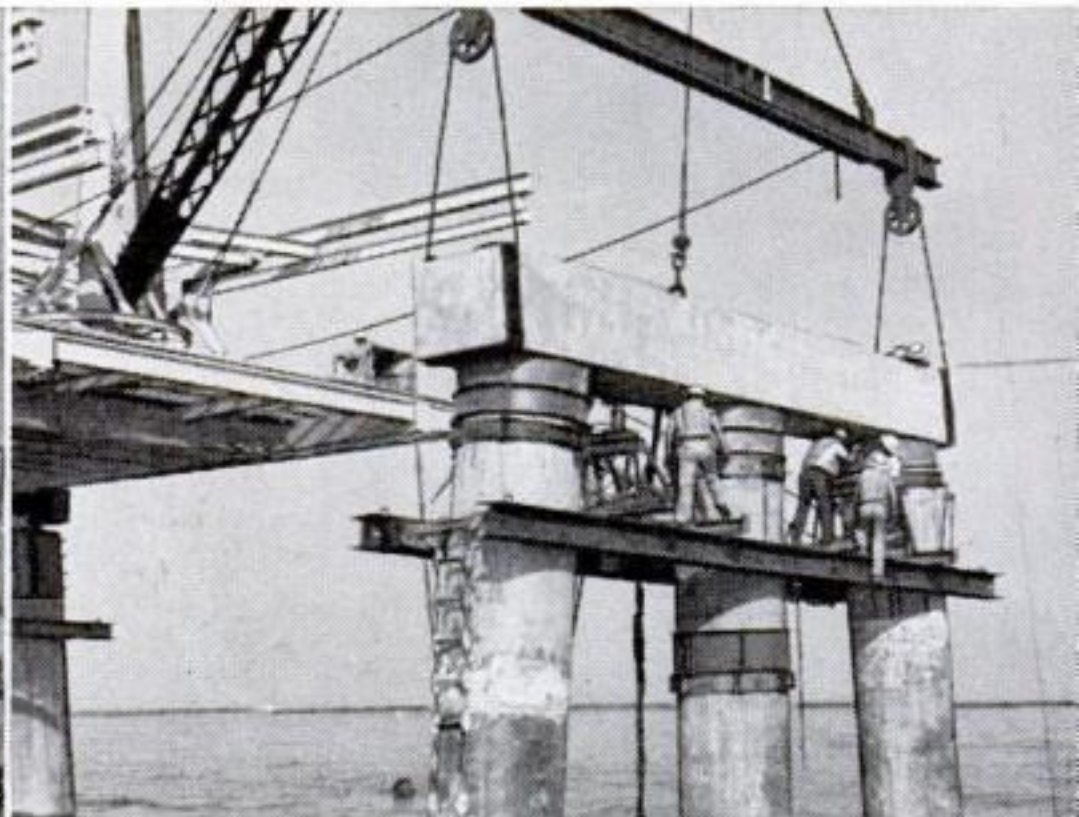


BRIDGELIKE MONSTER, whose 180-foot deck over-reaches two trestle spans, does two jobs: Front end (at left) cuts off piles evenly.

Rear end puts crosspieces on them. In photo, it's finishing this and is about to roll forward, over wheels just placed on piles ahead.

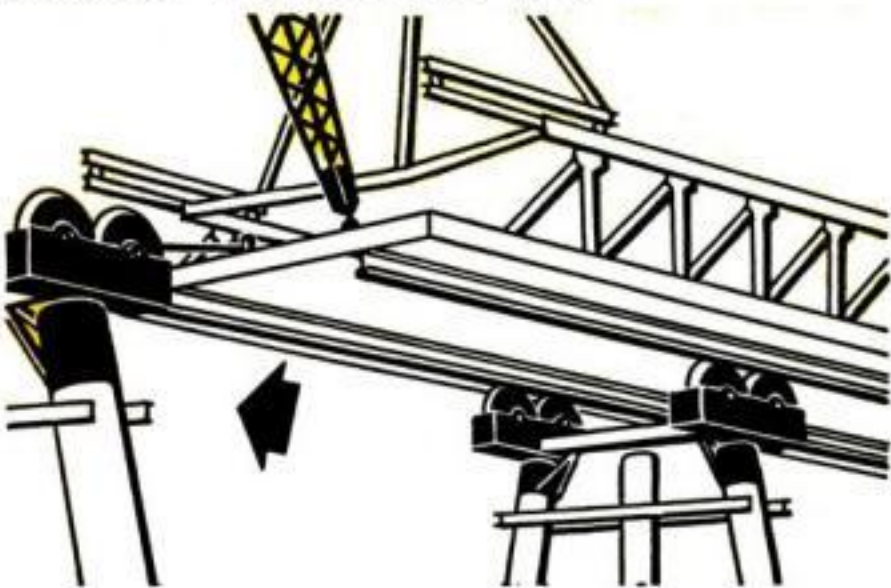


AT FRONT of Monster, crane suspends platform around pile to be cut off—and workers chip through concrete with jackhammers on circular track. Wires in wall are cut with torch.



CONCRETE CROSSPIECE is lifted from barge and set in place on a row of leveled piles by crane at rear of Monster. Called a bent cap, it will support slabs forming trestle's deck.

Monster Travels This Way



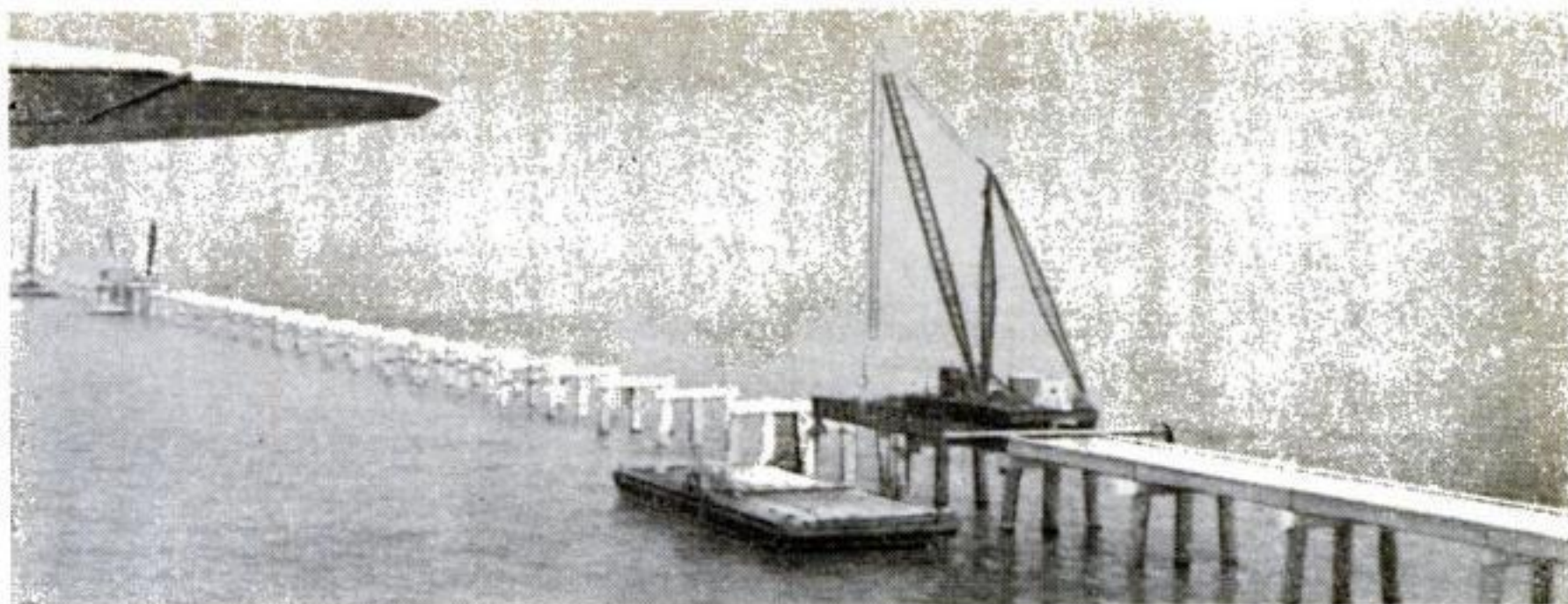
MACHINE ADVANCES, on upside-down rail track, by winching in cable attached to a pile ahead. Rails on the Monster engage flanged wheels in trucks temporarily set atop leveled piles.

comes the Two-Headed Monster, which levels the tops of the piles and puts crosspieces on them. Bringing up the rear, the Slab Setter lays the deck of the trestle on the crosspieces.

Devised especially for the project, these machines are unique. Floating ones have built concrete trestles in sheltered waters—but here, practically in the Atlantic Ocean, waves would rock them and make their operation impossible. So the Big D stands on the bay's bottom, the Two-Headed Monster rolls over the tops of piles, and the Slab Setter swings along on them in horizontal cartwheels.

It's a waterborne operation. Crews get out to their machines and back by

And the Slab Setter virtually completes the trestle

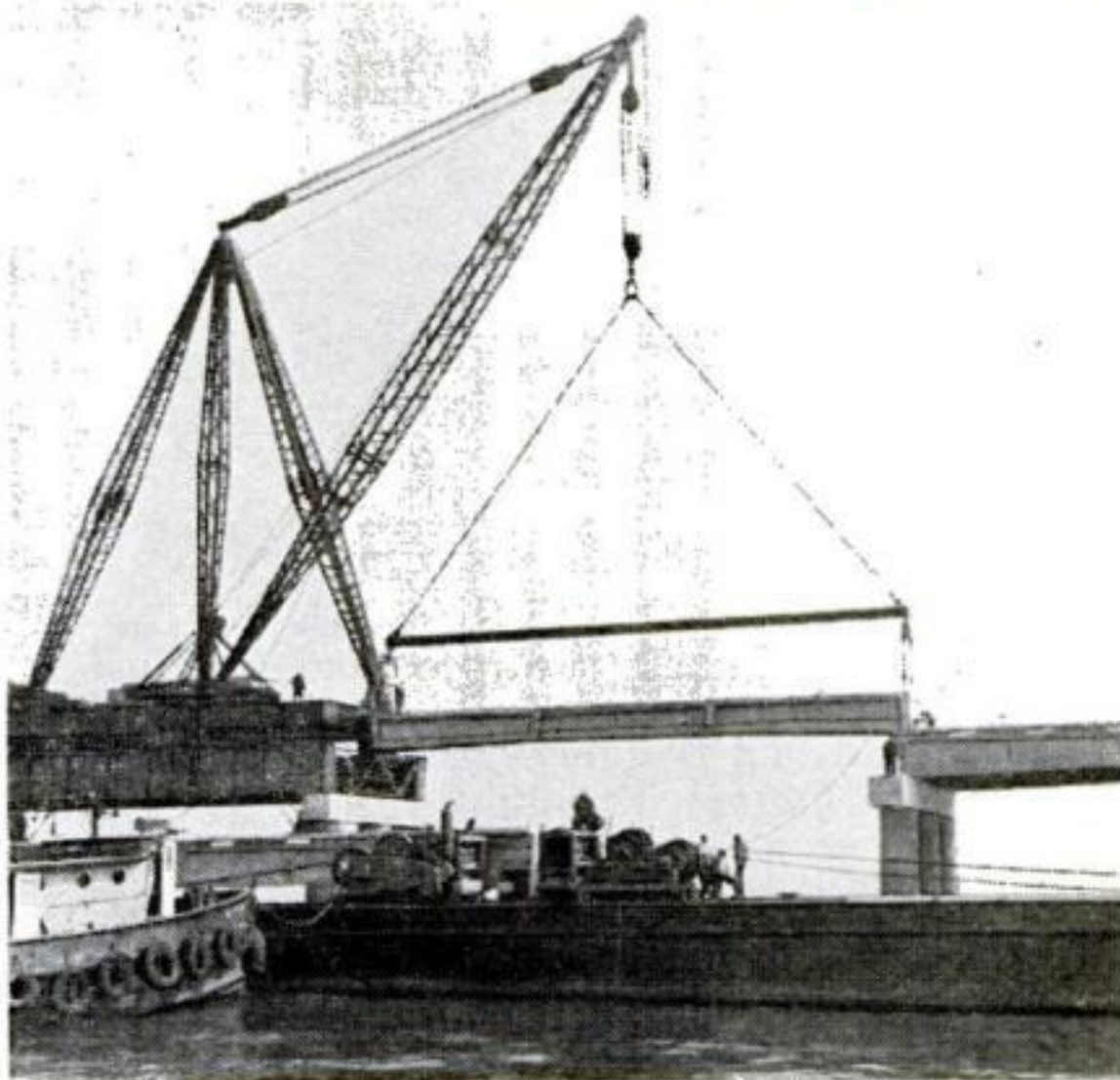


SLAB SETTER, the third and last in the procession of big trestle-building machines, adds the trestle's deck—consisting of four parallel slabs of concrete for each 75-foot span of the trestle.

Behind the Slab Setter—at right, in this airplane view—trestle is nearly finished. Lighting, handrails, phones, and a black-top roadway surfacing will ready it for coming streams of traffic.

FIRST OF FOUR SLABS for a deck span is lifted from barge and swung into place by crane of Slab Setter. One-piece concrete slab combines deck surface and its supporting girder. Steel pins on crosspiece engage recesses in slabs to fasten them.

Like the Big D and the Monster, the Slab Setter is self-propelled. It has its own strange method of locomotion, shown below, right.

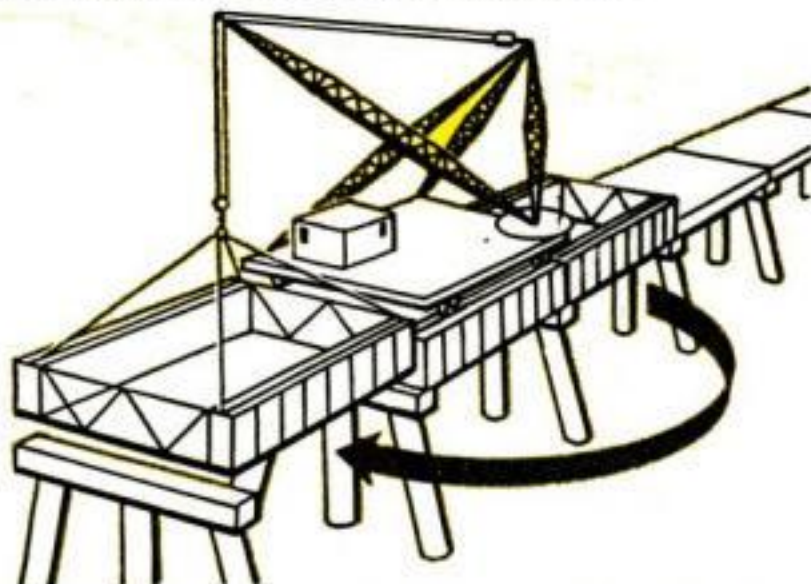


boat—and wear life preservers, as well as hard hats, for safety on the job. Two-way radio links machines, boats, and construction headquarters ashore. So fanciful nicknames make sense—"Two-Headed Monster" is a lot simpler to say, by radio, than "pile cutoff traveler and bent-cap setter."

From a starting point near the Chesapeake Beach shoreline at the south end of the crossing, this mechanical parade is marching northward across the bay at a rate of about two 75-foot spans daily. It leaves behind it a trestle needing only a few finishing touches for use.

At ship channels. Vessels need more clearance than the low trestle affords.

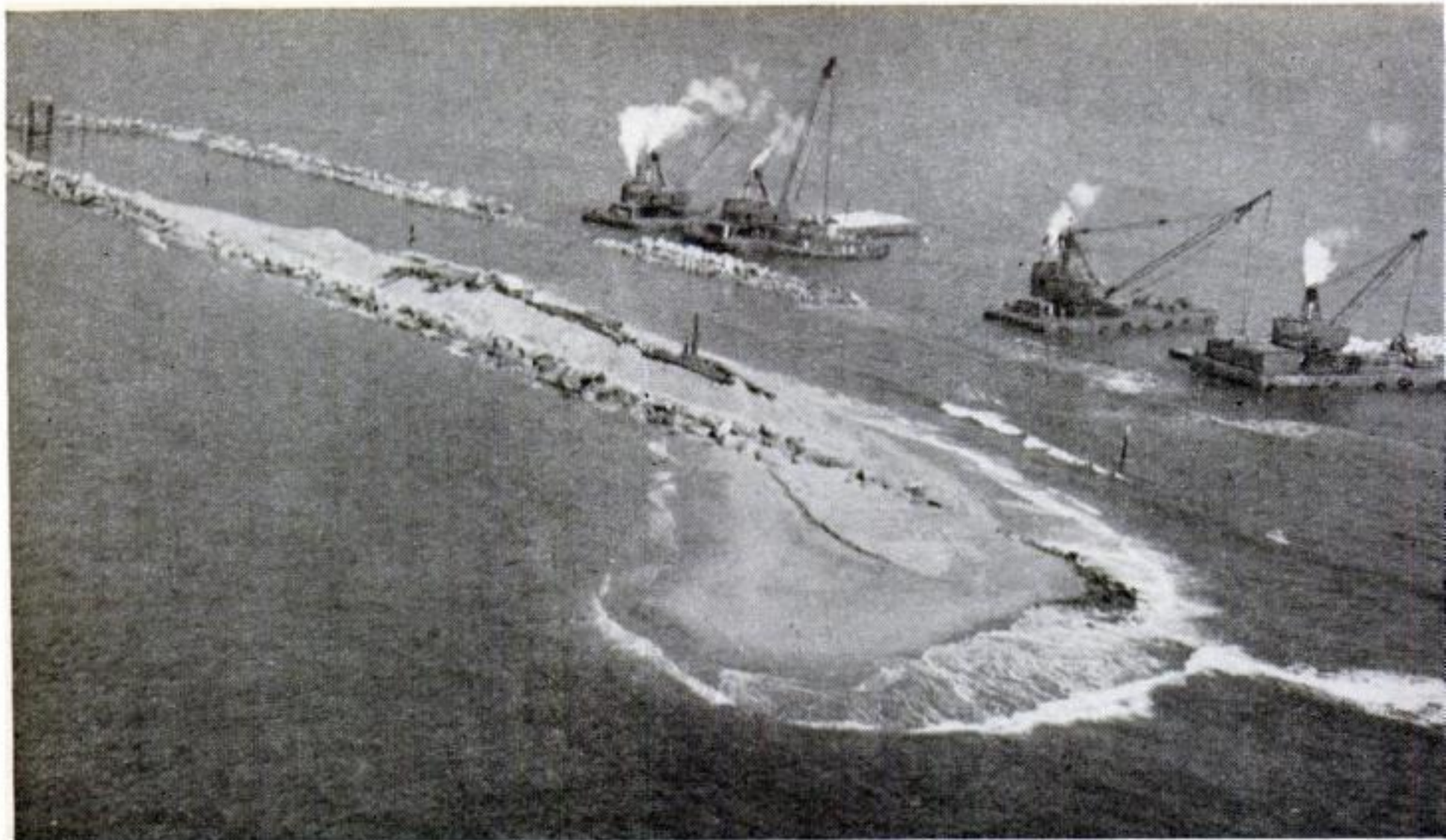
This Machine Does Cartwheels



TO MOVE AHEAD, Slab Setter rolls its crane to forward half of two-section bed. Then crane reaches back, picks up rear section of bed—and swings it around to front, as shown.

CONTINUED

To cross major ship channels, bridge turns into tube—and artificial



MAN-MADE ISLAND, one of four, emerges from Chesapeake Bay. Wall of rocks, which air view shows being built by floating cranes, will be filled with sand from bay bottom. Finished

islets will be about 1,500 feet long, 230 feet wide, and 30 feet high. On one, a restaurant for 300 will offer dining and dancing; and one or more will have fishing facilities.

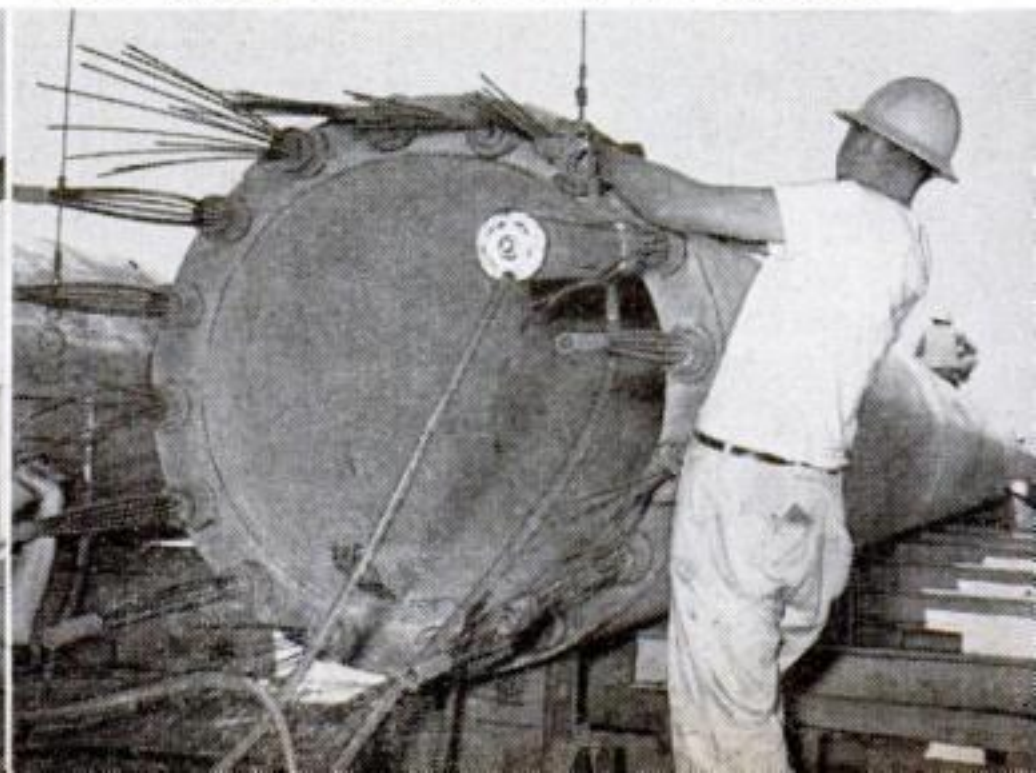
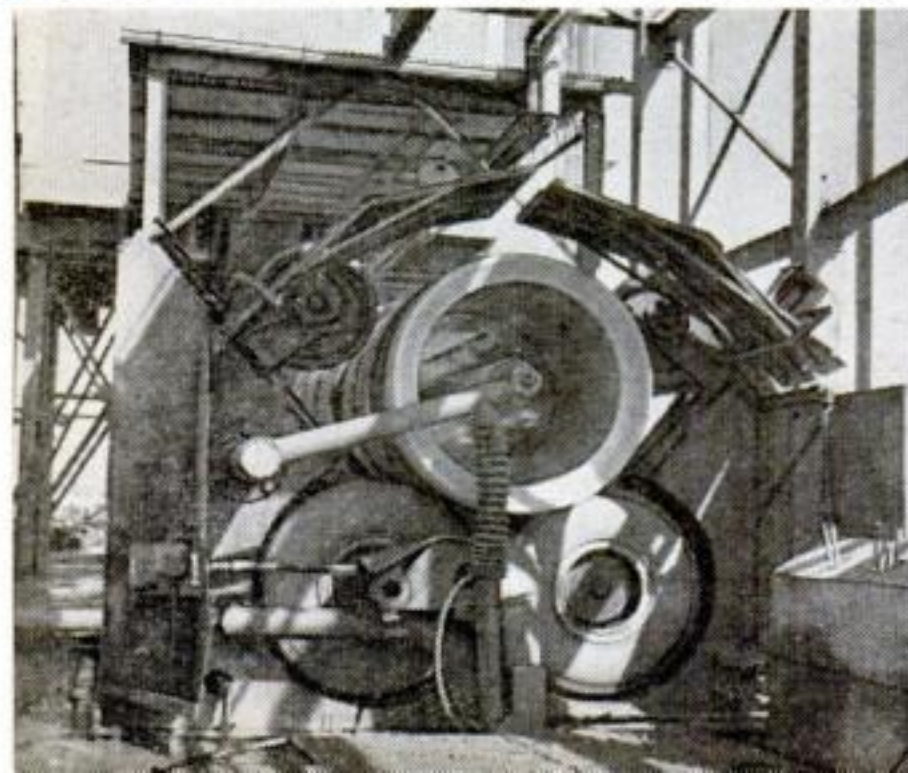
So two-lane vehicular-tube sections, each 287 feet long, are being towed out and sunk in trenches across the bottom of Thimble Shoal and Baltimore Channels—the two principal shipping lanes. Joined, the sections will form tunnels dipping to 100 feet below the surface of the water, and ships will sail over them unimpeded.

The engineers favored tunnels here because of the greater cost of bridges high enough for ocean liners and naval vessels. And a clinching pro-tunnel argument came from the Navy—the danger of having its warships bottled up at their Hampton Roads base if a bomb-wrecked bridge span fell into the Thimble Shoal Channel and blocked it.

At a casting yard across the bay, concrete piles for the trestle

MAKING A PILE begins with pouring concrete into whirling mold. Spinning mold at 450 r.p.m. gives 16-foot-long pile section final shape: a tube with five-inch wall, 54-inch diameter.

LIKE BEADS ON STRING, pile sections are assembled on wires threaded through holes in walls. Stretched by jacks, wires prestress concrete—put it under pressure, for strength.



islands link trestle and tunnel



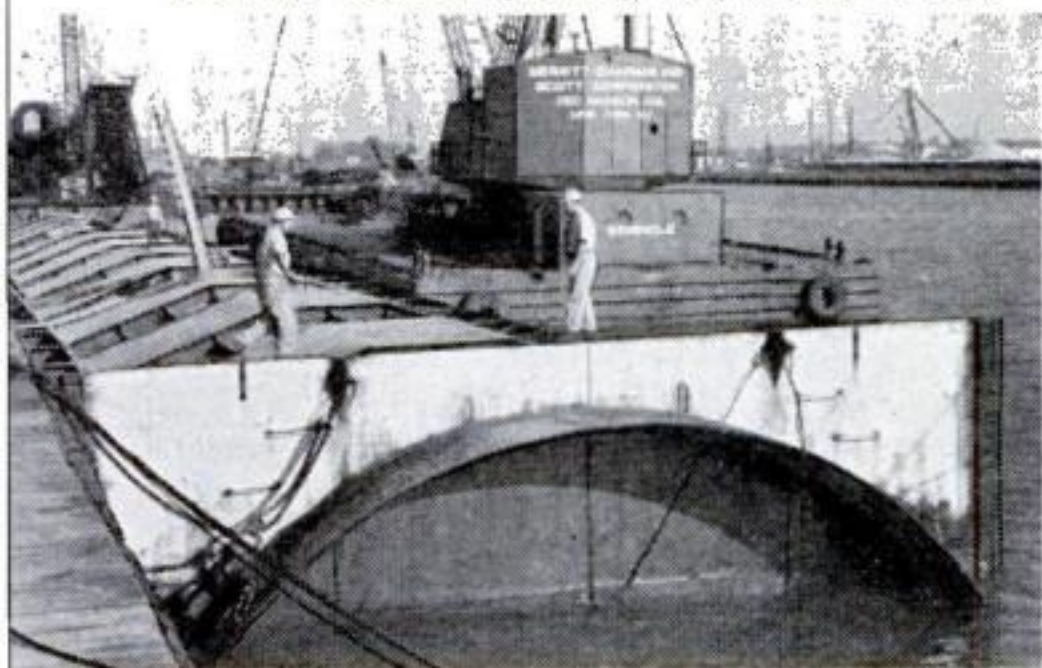
SECTIONAL VIEW shows how island joins trestle and tunnel. Two vehicular tubes, 5,738-foot

Thimble Shoal Tunnel and 5,450-foot Baltimore Channel Tunnel, duck under main ship lanes.

In contrast, only fishing vessels of modest size use two minor channels near the crossing's north end. So a pair of middling-high bridges, rising no more than 75 feet above water, proved the more economical choice there.

And, last, a 9,000-foot causeway on an earth-fill embankment will cross a natural steppingstone—Fisherman Island, near the bay's north shore. So the big project combines a little of everything.

TUNNEL SECTIONS like this 287-foot one, sealed for towing, will be sunk in trench below channel bottom. Joined, they'll form tube.



Designers have anticipated contingencies from hurricanes down to common motoring mishaps. The 30-foot elevation of trestle, islands, and tunnel portals is calculated to safeguard them against a hurricane with 105-m.p.h. wind, a 10-foot rise in sea level, and 14½-foot waves on top of that. Watertight doors, which can close the lower-level portals of the nearby Hampton Roads tube against flooding, are considered unneeded here; the tunnels' regular drainage system will be able to handle any spray that enters.

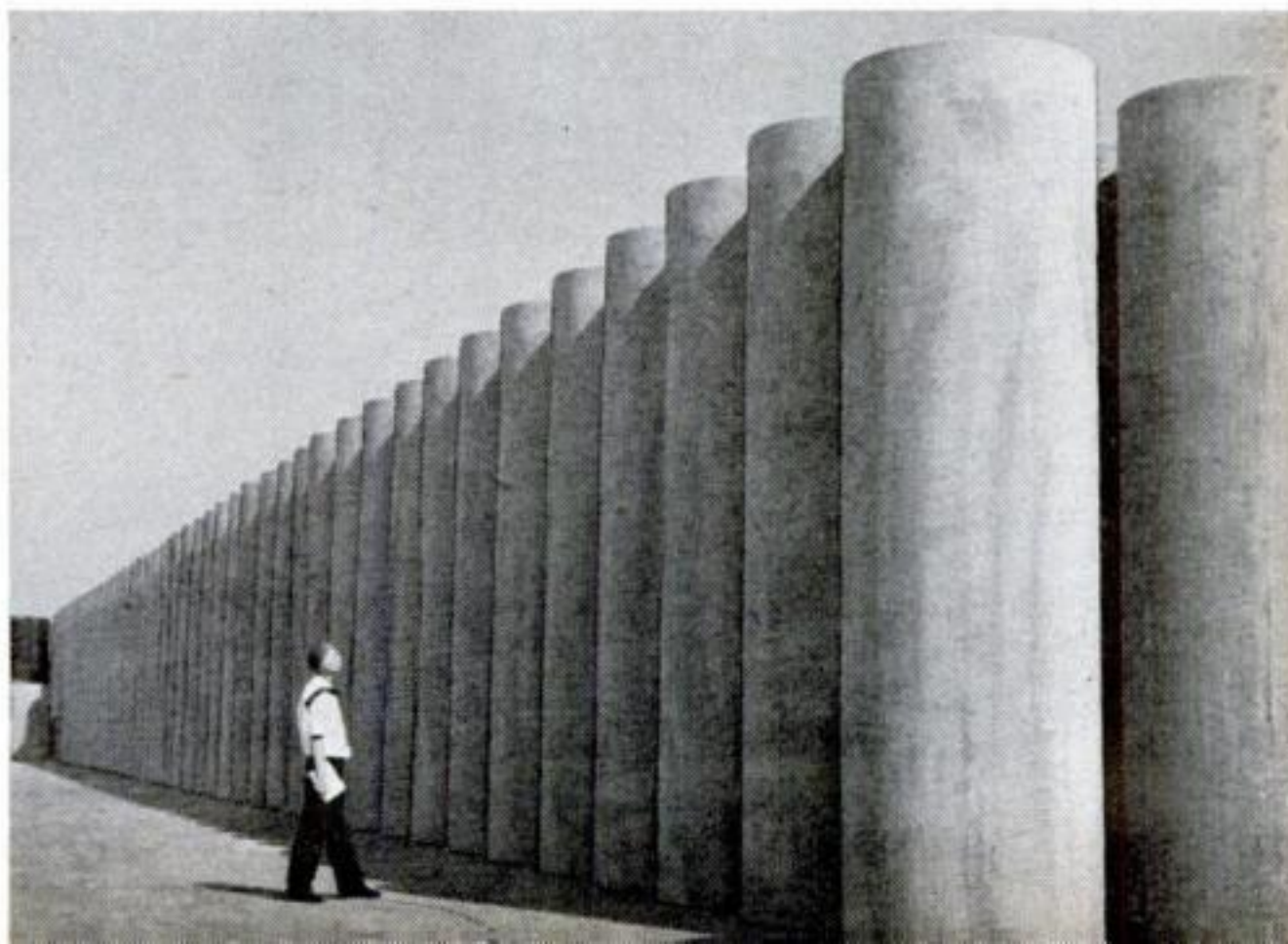
Should a car stall on the bridge-tunnel, the 28-foot-wide roadway will give the two lines of traffic room to pass. Roadside phones will enable a driver in trouble to summon aid. Patrol cars crossing frequently, and tow cars and fire equipment based on the artificial islands, will be ready for emergencies.

Engineering feats even comparable with the Chesapeake Bay Bridge-Tunnel are hard to find. Louisiana's 24-mile highway bridge over Lake Pontchartrain, finished in 1956, set a record for length that still stands—but was in calm water,

[Continued on page 218]

of the Chesapeake Bay Bridge-Tunnel are mass-produced

STACKED IN YARD, standard 16-foot pile sections await assembly into piles of any desired length. Stringing 10 together, for example, makes a 160-footer. Mass-produced at the same casting yard are the concrete slabs for the trestle's deck—which also are prestressed—and the concrete crosspieces. From casting yard's site on bay shore, a few miles beyond north end of bridge-tunnel, barges deliver products to scene of construction.





Island-hopping hydrocopter

The Swedish boat above travels on ice or water. Built of mahogany with a fiber-glass bottom, it's driven by an air-

craft propeller, will make 80 m.p.h. on ice, 25 on water. It runs between isolated islands off northern Scandinavia, holds three persons, and can be adapted to carry a stretcher.



Merry-go-round for baggage

First of its kind at travel terminals, a merry-go-round has been installed to deliver luggage to passengers arriving by United Air Lines at San Francisco's International Airport.

The dispenser receives suitcases and handbags from a chute, slides them to its rim, and then turns slowly to enable waiting passengers to lift them off or point them out to an attendant. The stainless-steel Lazy Susan is 25 feet in diameter and holds up to 125 bags.



Light aluminum wrench

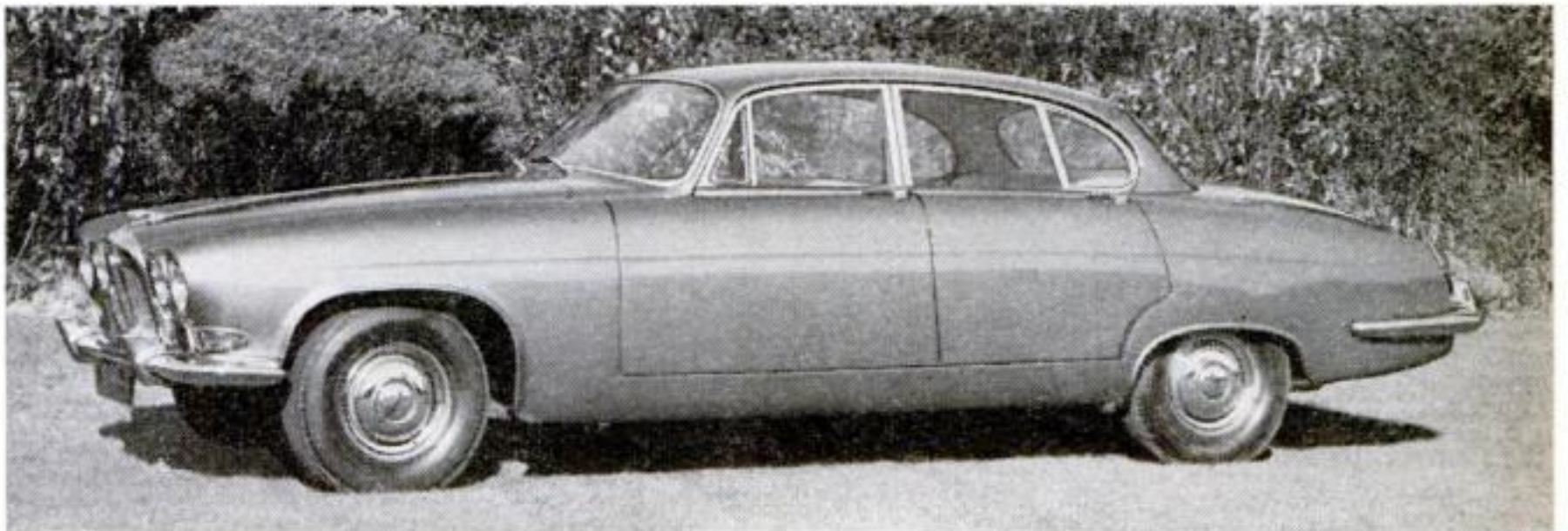
A big ratchet wrench forged from aluminum alloy weighs 43 percent less than a steel wrench of equal strength and is much easier to use in awkward positions. Here a mechanic works with one on inverted bolts and nuts without help in holding it in place. The wrench is made by Proto Tool Co., Los Angeles.



Sextet from the sky

Arms interlocked, six Royal Air Force instructors from Britain's No. 1 parachute-training school are shown practicing

a group free fall in this remarkable photograph. They jumped together from their plane at an altitude of 9,000 feet, separated at 7,000 feet, and opened their chutes when well apart at 2,000 feet.



Trim, low profile for latest Jag

The all-new Jaguar Mark X is a sleek, luxury-appointed four-door with 120-m.p.h. performance. Its power plant is a highly tuned 230.6-cu.-in. twin-overhead-cam six delivering 265 hp.

Independent rear suspension combines jointed half-shafts with swinging tubular links; twin coils on each side enclose telescopic shocks. Rear disk brakes are mounted inboard to reduce unsprung weight. Front disk brakes have a separate master cylinder. Brakes, steering, and even ventilator-heater controls are power-assisted.

The unitized body stands only 4½ feet high, is 16 feet, 10 inches long. Wheelbase is 120 inches.

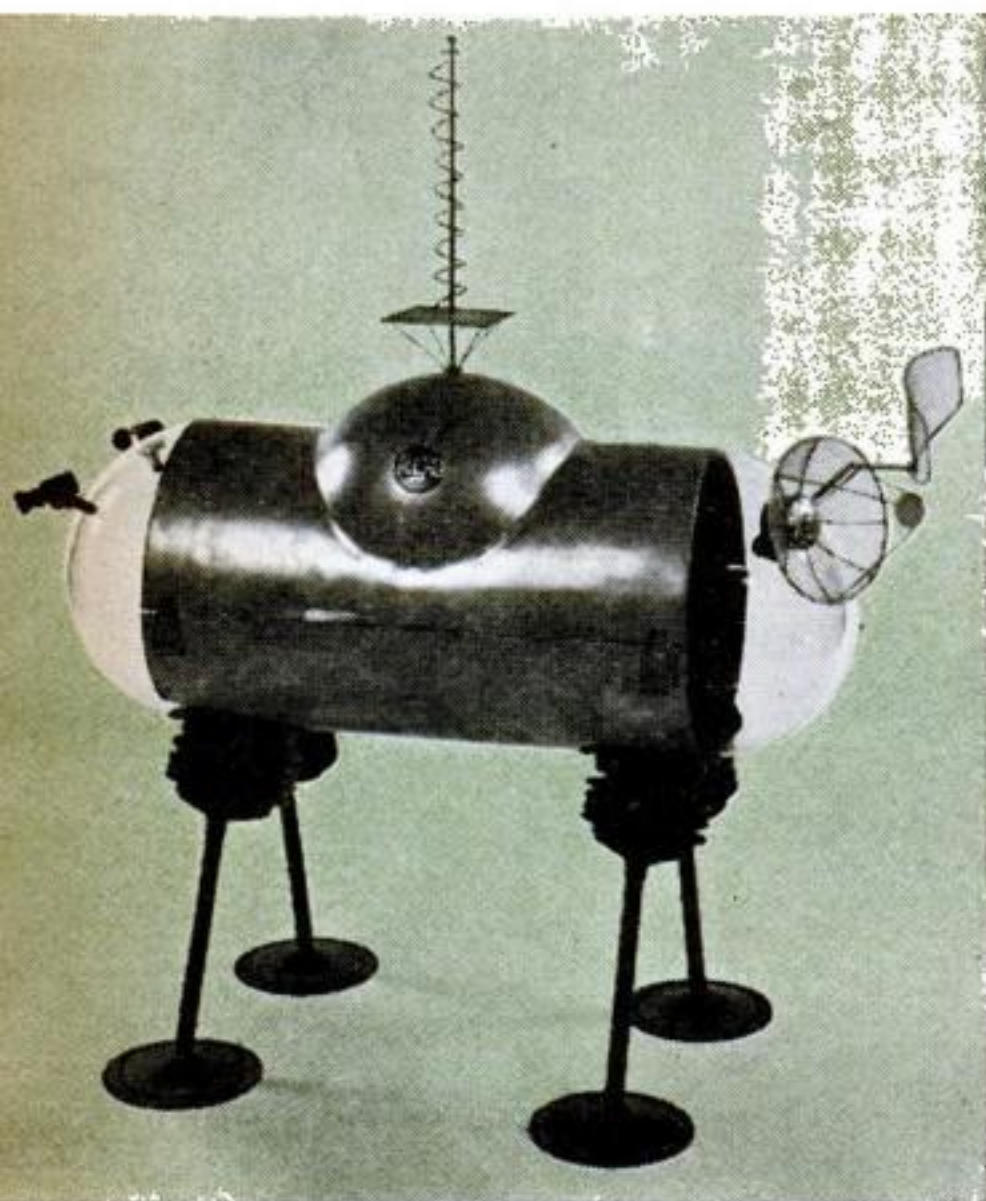


WALNUT PANELS in backs of reclining front seats are hinged to make convenient picnic trays. Interior trim is rich leather, carpets deep-piled.

Weird Robots to Explore the Moon

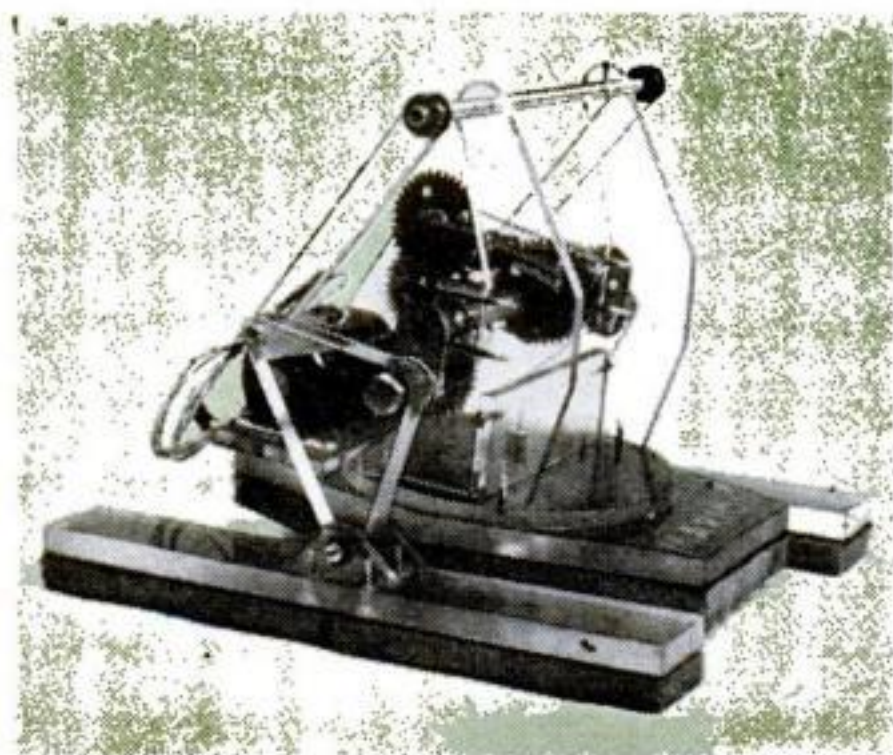


SIX-LEGGED MOON VEHICLE, one of RCA's walking versions, resembles grotesque bug. What looks like a proboscis is soil-sampling drill; head is counterweight for it; and "feelers" are radio antennas.



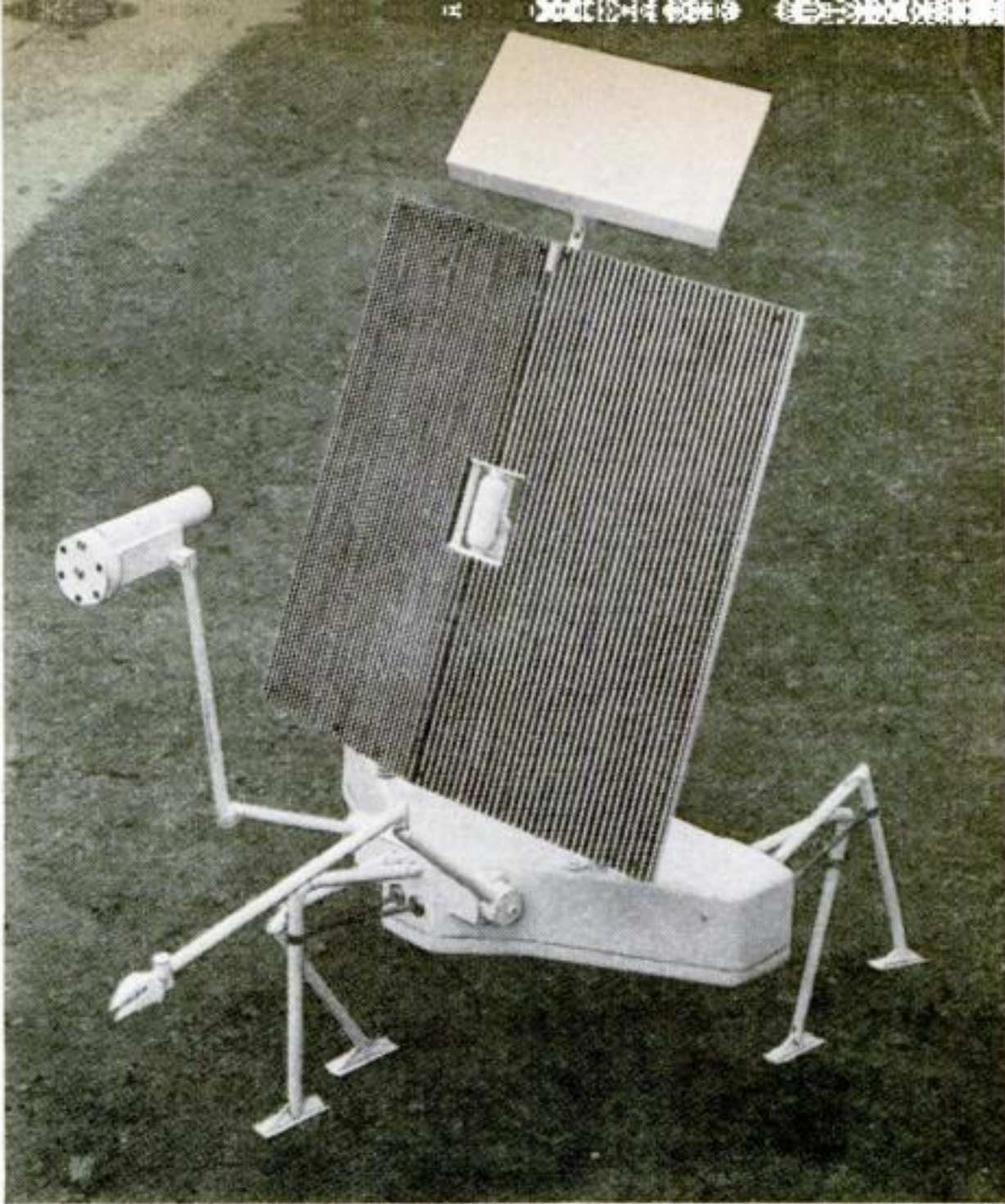
WALKER WITH FOUR LEGS moves one of them at a time—up, forward, and down. It shifts its center of gravity backward before lifting front legs (at left), and forward before raising hind legs. Slow speed, no drawback, aids in remote control.

FLAT-FOOTED PLODDER alternately advances a wide center foot, then the two narrower ones at each side of it. Design is demonstrated by small electric-powered model.



By Wesley S. Griswold

Nobody knows just what the lunar terrain is like—so vehicles may travel on legs or spheres or screws, to look it over before the first men get there



FULL-SIZE MOON STROLLER built by Space-General weighs only 135 pounds—and could be one of first put on moon. It walks on six feet, has claw and TV camera on arms. Ribbed solar panels supply power.

FROM U. S. designers are coming weird vehicles that walk, crawl, waddle, and claw their way. They look more appropriate to another world—and that's precisely their idea. For one or another may be just what it takes to scurry over the surface of the moon.

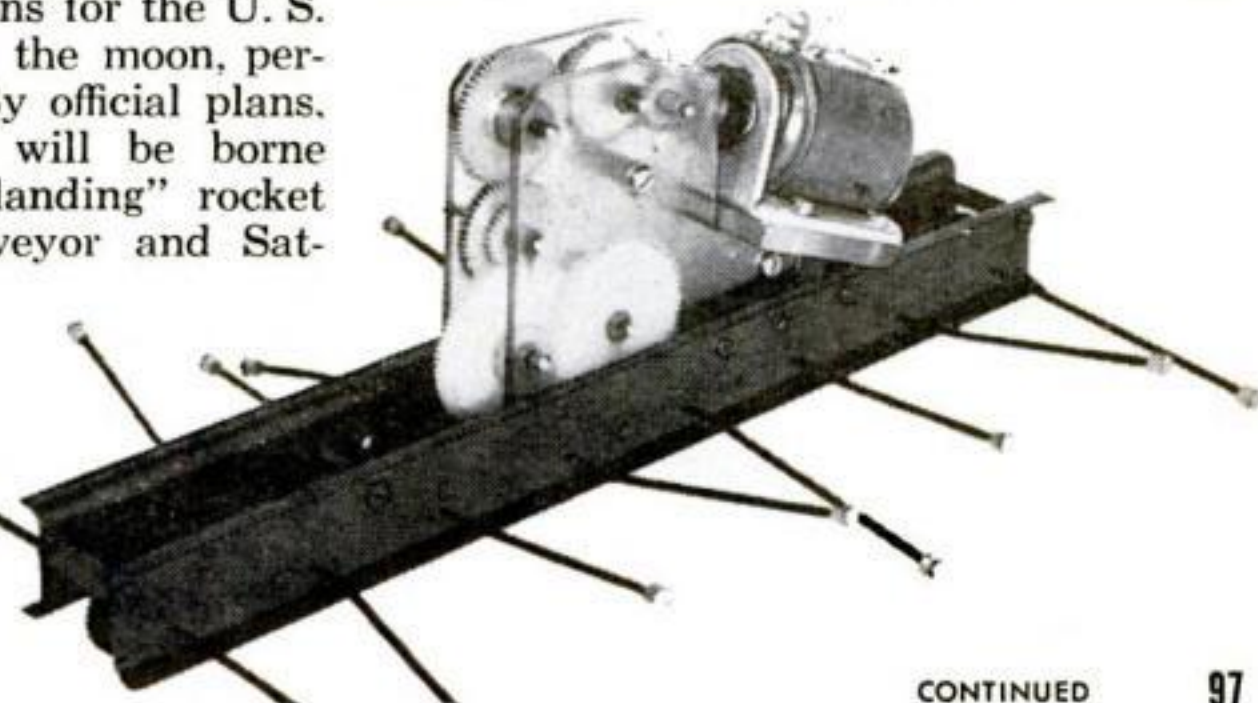
First to explore the lunar terrain will be crewless "rovers" such as these, remotely controlled from earth. What they find will guide preparations for the U. S. attempt to land men on the moon, perhaps as soon as 1967. By official plans, the unmanned vehicles will be borne there by our first "soft-landing" rocket craft—Atlas-boosted Surveyor and Sat-

urn-boosted Prospector—and should be ready to go between 1963 and 1966.

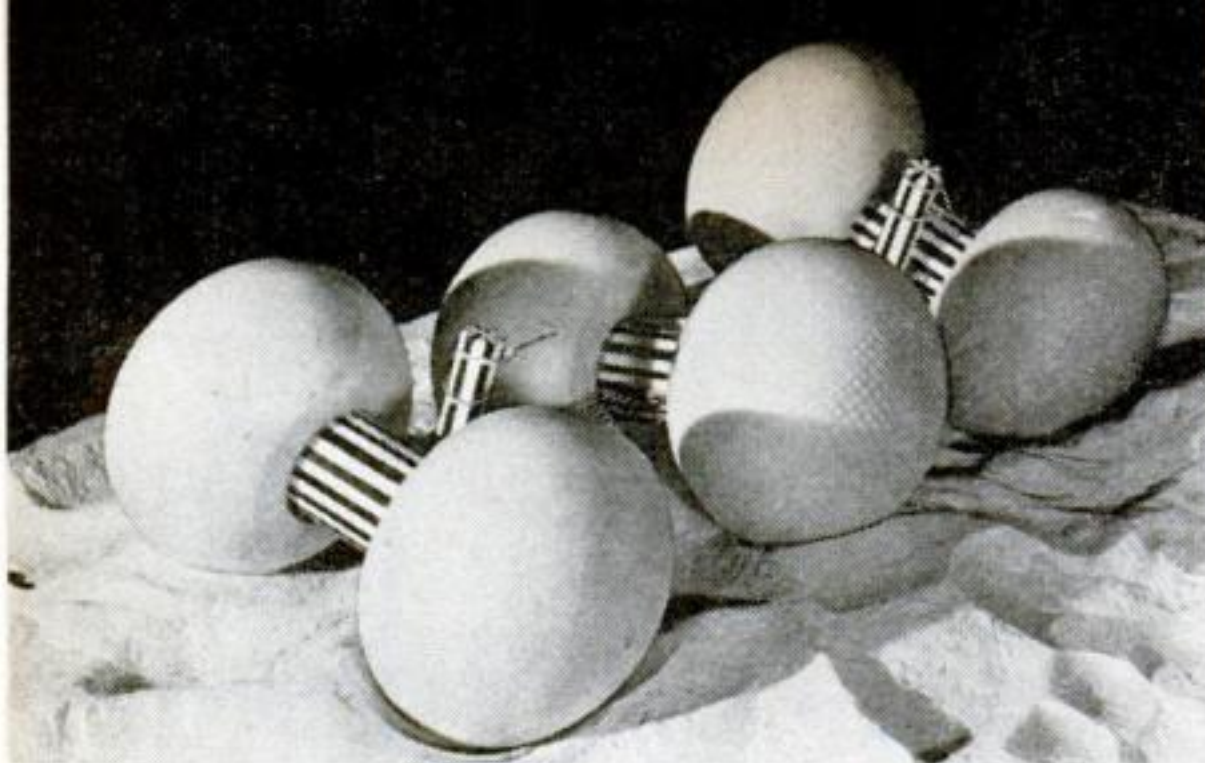
So designing a moon car has become urgent. Working on it are engineers of at least 10 leading space firms. Models ranging from toy size to full scale show what they've come up with so far.

Space-General designers have built an insect-like vehicle with six legs, two arms, a triangular body, a solar-cell

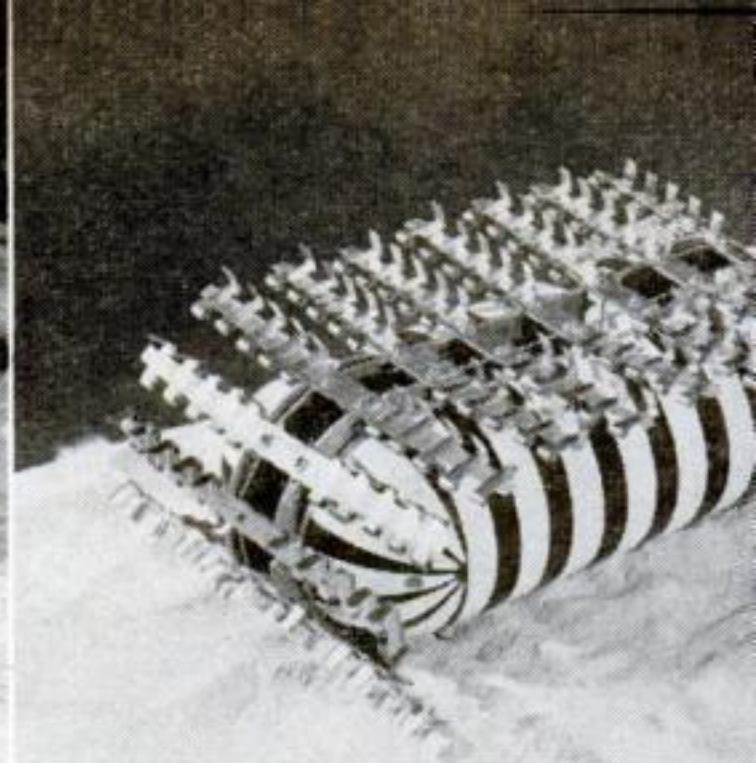
CENTIPEDE-STYLE moon car crawls on 16 legs (which extend sideward like oars) by rotating pairs in sequence. Four legs at a time support it. To make turns, the rows of legs on opposite sides are operated alternately.



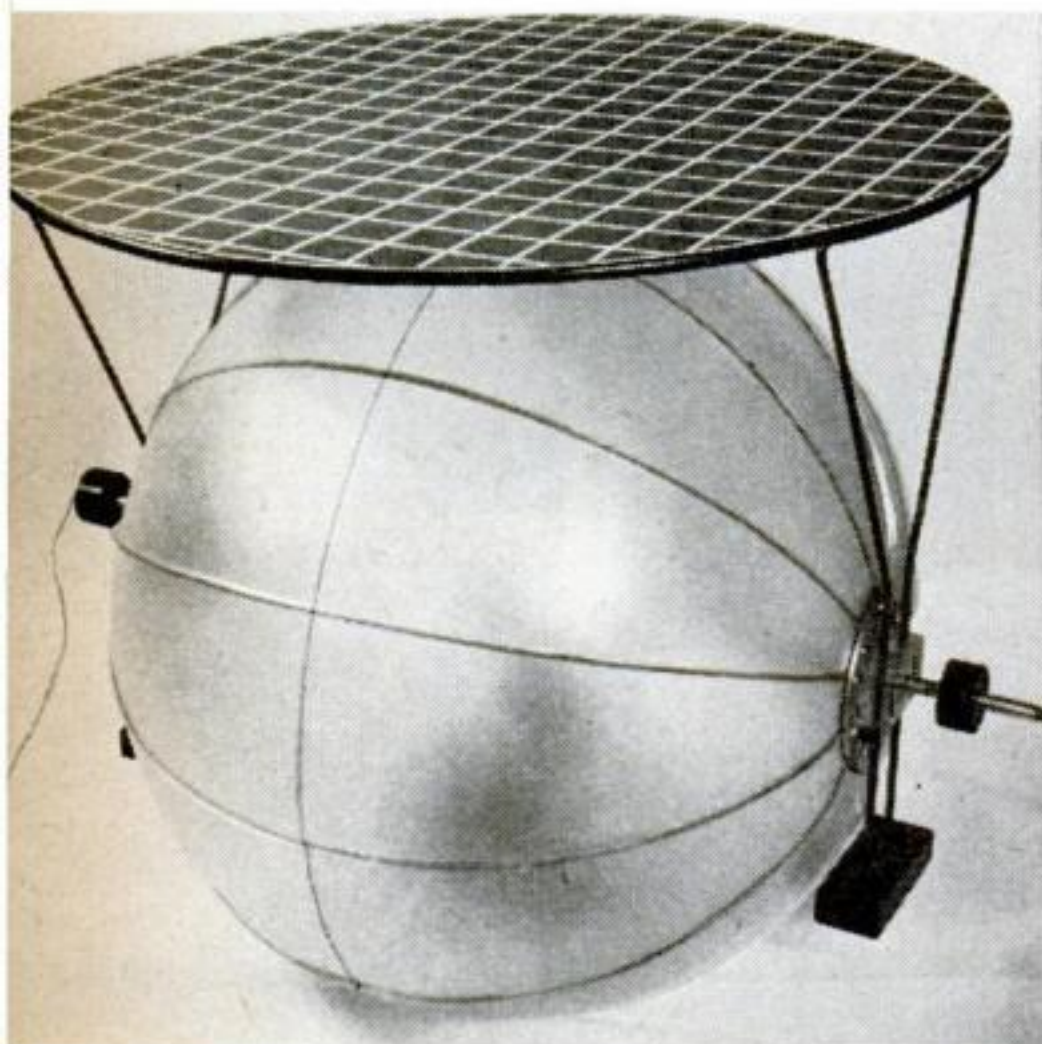
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THREE RADICAL DESIGNS getting GM tests include this vehicle with three pairs of doughnut-shaped rollers in tandem.

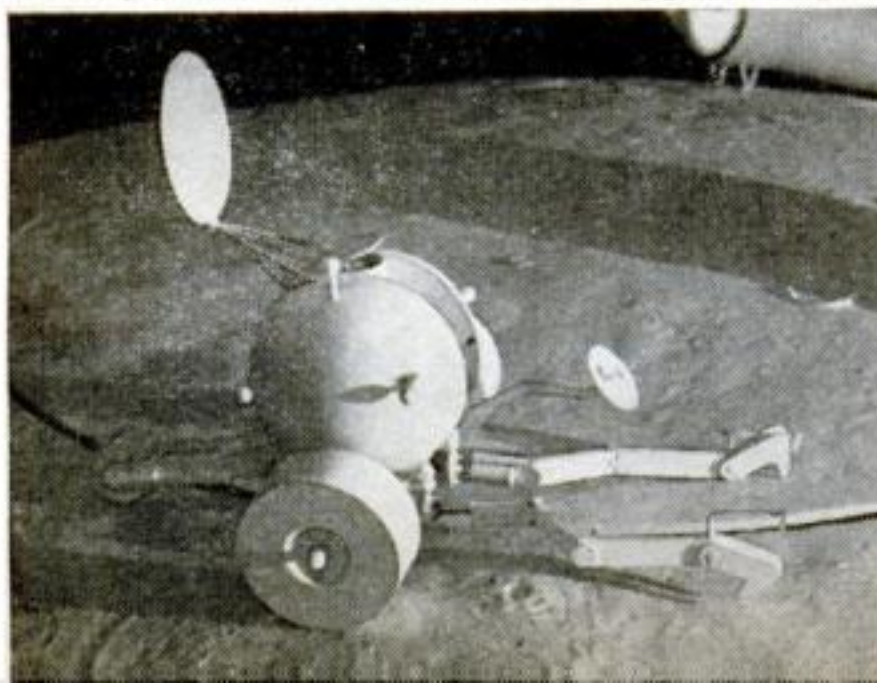


WRAPAROUND TREADS completely encircle bodies of coupled cars,



INFLATED BALLOON of 100-foot diameter is RCA idea for moon vehicle that could roll over high obstacles. Big disk at top, balanced by counterweights, collects solar energy for power.

CLAWING ITS WAY, one-ton "globular chariot" designed by Sperry Rand hauls itself along with hooks on two jointed arms. Two large rollers, and smaller one behind, support weight.



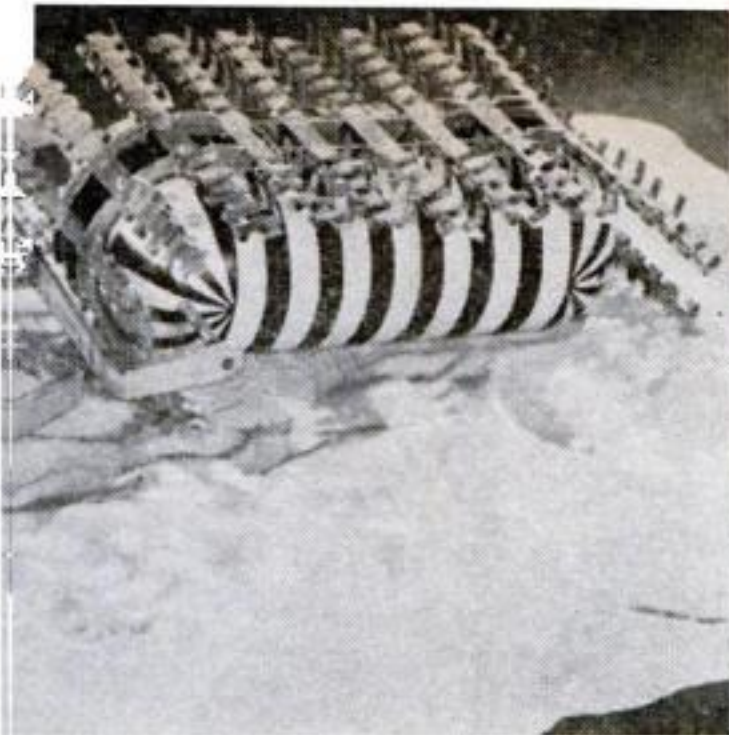
panel, and an antenna. The left arm, ending in a claw, picks up objects to examine. The right one holds a TV camera to do the looking—and to see where the vehicle is walking. This lightweight 135-pound rover will fold to compact 40-by-40-by-12-inch size for rocketing to the moon, where it's expected to operate for at least two months.

The moon bugs. Even more buglike are a strange menagerie of walking and crawling models, sporting from 3 to 16 legs, brought forth by RCA's Astro-Electronics Division. All have TV cameras for eyes, and line-of-sight radio links with earth for control. They can move forward or backward, and make turns.

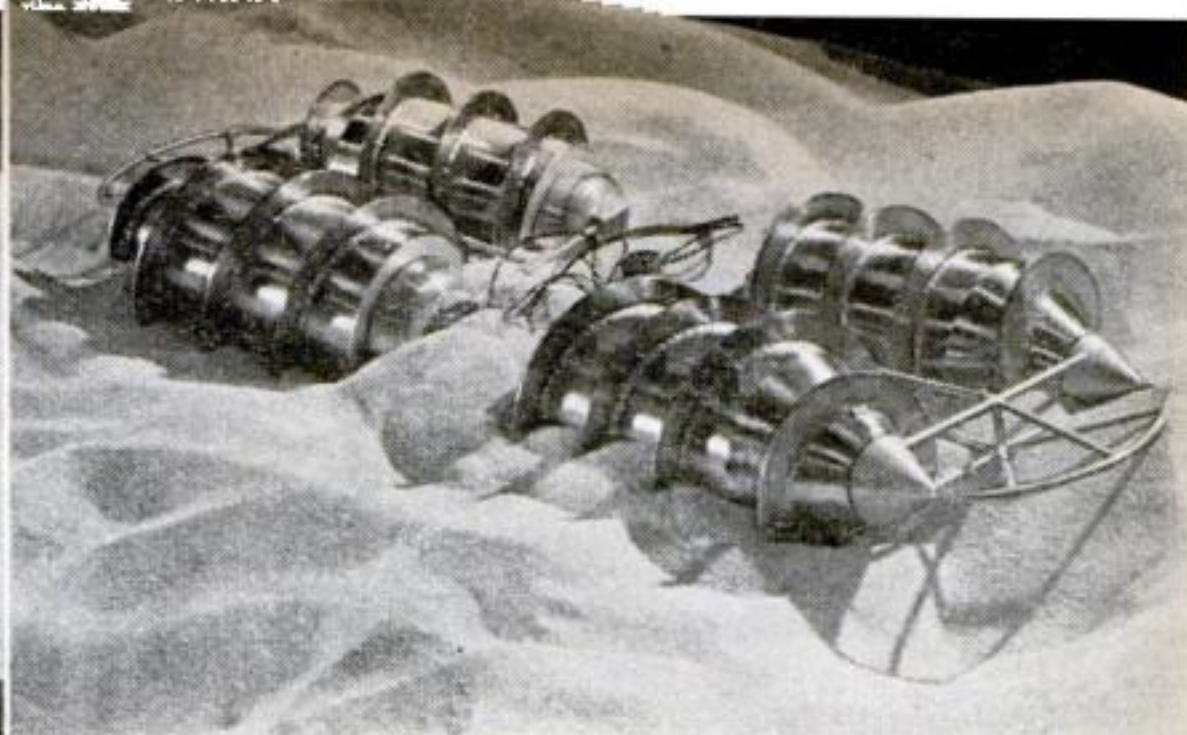
A huge rolling balloon of 100-foot diameter is another RCA brainchild. Collapsed for rocket delivery, it would inflate itself on landing, probably with evaporating solids. Its material would be strong, pliable, light, and puncture-proof. For a power source it would carry an enormous disk of solar cells like a parasol. Batteries and instruments, slung in pods, would serve as counterweights to balance the disk.

In a soil bin at Santa Barbara, Calif., General Motors' Defense System Division is testing a trio of novel designs with small electric-powered models. Three pairs of doughnut-shaped rollers in tandem propel one model. An endless tread entirely encircles the bulbous body of a second design.

Most curious of all, the third model rides paired screws, turning in opposite directions. To steer, it varies the twin screws' relative speeds. Even if buried by a slide, it could burrow its way out.



in second GM design. Electric model is getting soil-bin trial.



ROTATING SCREWS enable this GM vehicle to scuttle over soft ground—and even to extricate itself if it's buried.

Are moon-car designers overlooking such mundane things as wheels? Not entirely—but wheels for the moon may take new forms. North American Aviation envisions a collapsible wheel of metal-ribbon mesh, which folds like an umbrella for transport by rocket and unfolds again upon landing. It applies this scheme in a design for a four-wheel moon truck, 15 feet square, with a range of 300 to 500 miles in a two-week-long lunar day.

Offbeat locomotion. The why of other designers' methods of locomotion is easy to see. They already know about wheels and tracks. It's in case these won't work on the moon's unknown kind of surface that they're experimenting with more radical ways of travel.

And a walking moon car, for one example, may offer more advantages than you'd think. "It takes less power to walk through sand than roll through it," says a Space-General designer. "Besides, lubrication goes to pot in a vacuum. With legs, you can seal all the joints, or provide pivots that have no bearings."

"Of course," he adds, "legs won't be practical when bigger vehicles are needed, to carry more equipment."

As to size, most of the moon-car designs fall into two classes, to suit the rockets they're to ride:

Space-General's 135-pound featherweight represents a number of designs well within the 750-pound payload capacity of a Surveyor spacecraft's Atlas-Centaur rocket. In contrast, the mighty Saturn rocket—due to be ready by 1964—will enable a Prospector to put thousands of pounds of payload on the moon. So designs to ride the Prospectors are scaled up accordingly. An example is NAA's umbrella-wheel truck, weighing at least a ton and a half.

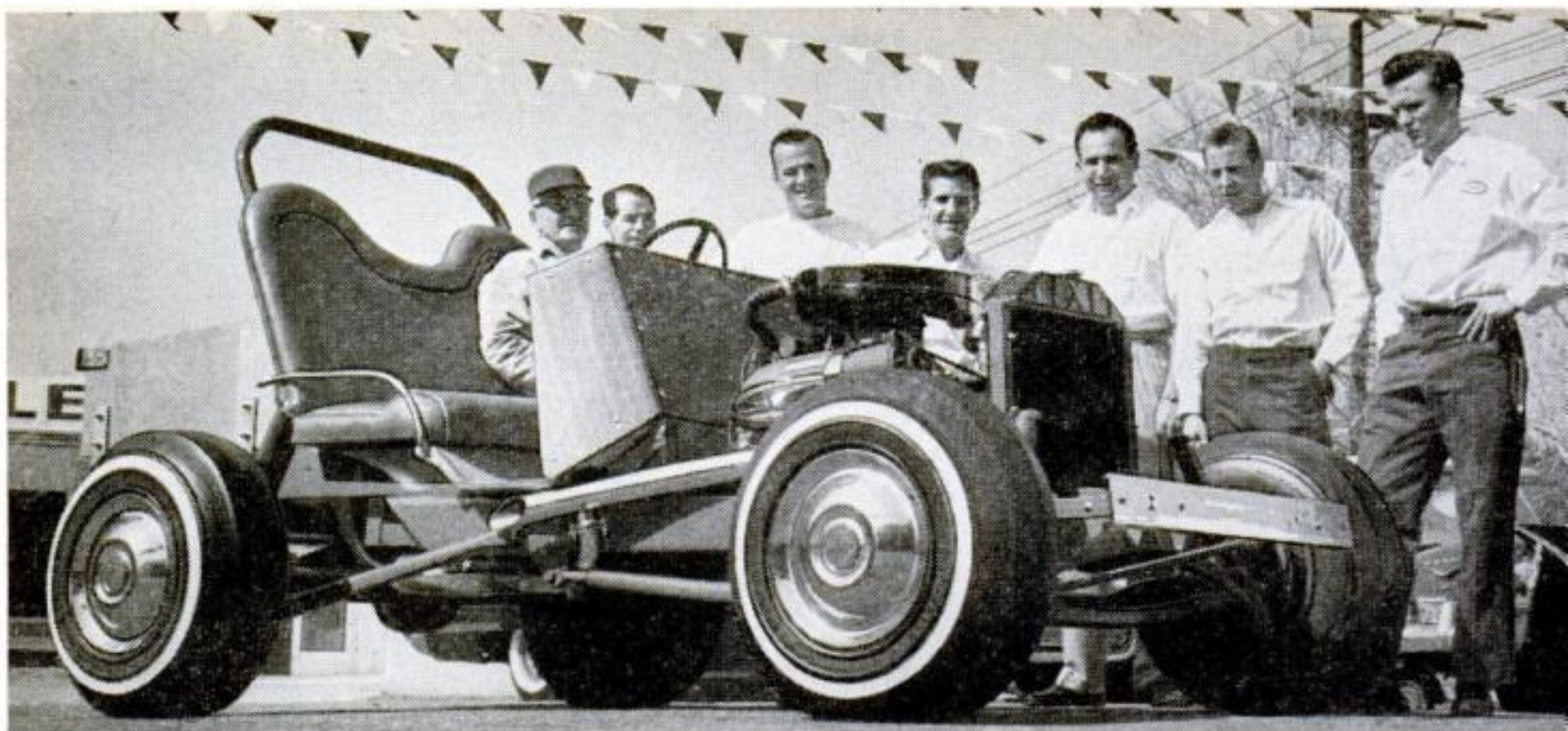
Another is a one-ton globular chariot, designed by Sperry Rand, that hauls itself along by claws on two jointed arms. Light, hollow rollers of spun wire support its weight, and a smaller roller behind them balances it. Besides propelling the vehicle, the claws can pick up

[Continued on page 214]

ACROSS 250,000 MILES of space, operator on earth will steer car on moon, by working control sticks. TV screen will show him what vehicle sees. Trial with models gives preview.

MODELS OF MOON, and of car with TV-camera eye, serve for remote-control trials at Airborne Instruments Laboratory. Obstacle ahead of car, seen by eye, appears on operator's TV screen.





DUNE-BUGGY CREW that built the car in two months of spare-time work includes the designer Huth (third from right). Unusual home-

made seat incorporates a sturdy roll bar as a safety precaution. The buggy is 131 inches long and weighs only about 1,500 pounds.

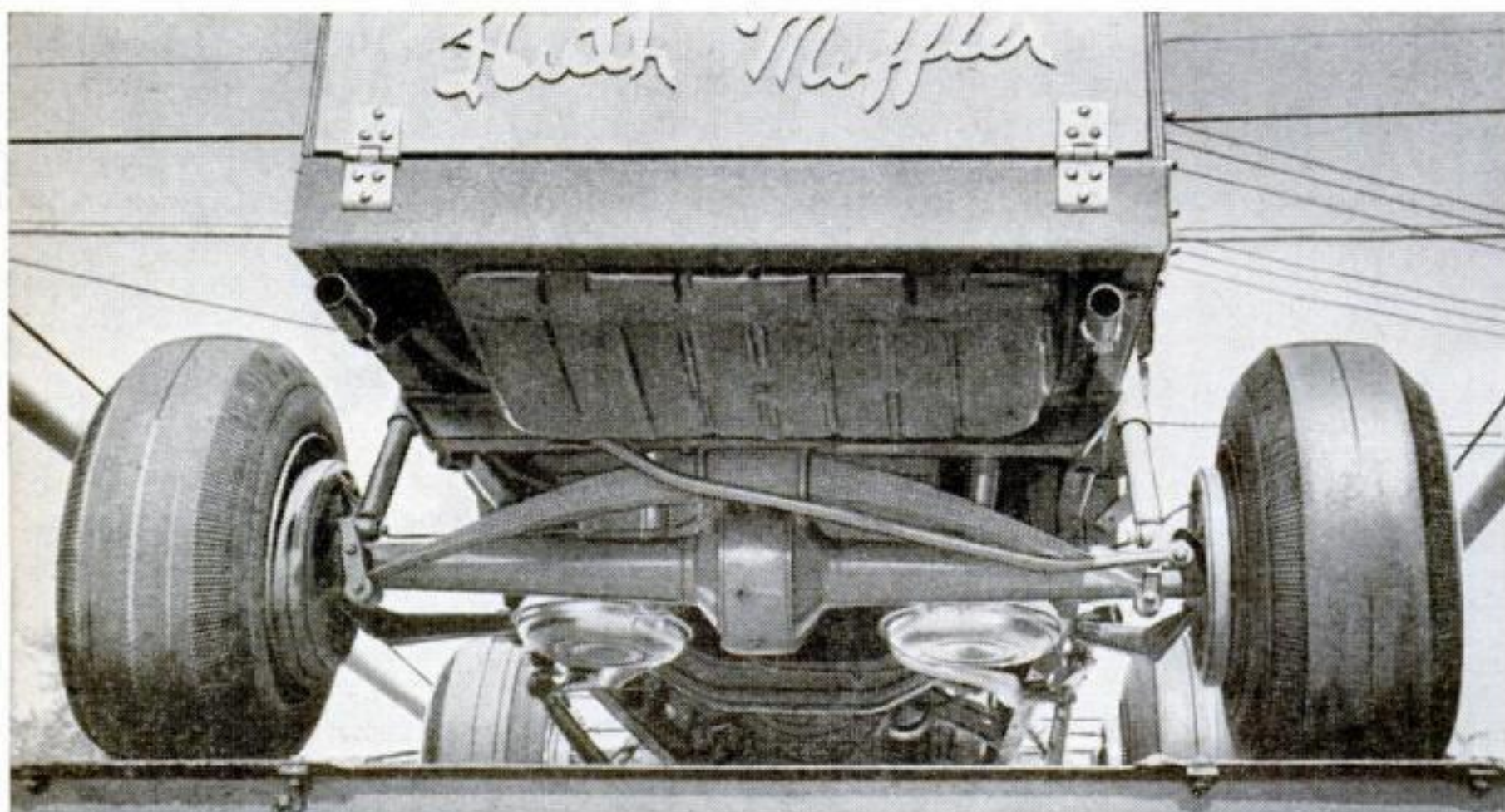
Desert buggy climbs the steepest sand dunes

Stubby, angry-sounding hot rods riding on fat, puffy tires are becoming a common sight in our Western desert areas. Called dune buggies, these stark, often bodyless cars can gambol across sand traps and up steep dunes that would stop even a four-wheel-drive vehicle.

The neatly functional buggy shown here, a combination of 1951 Cadillac V-8,

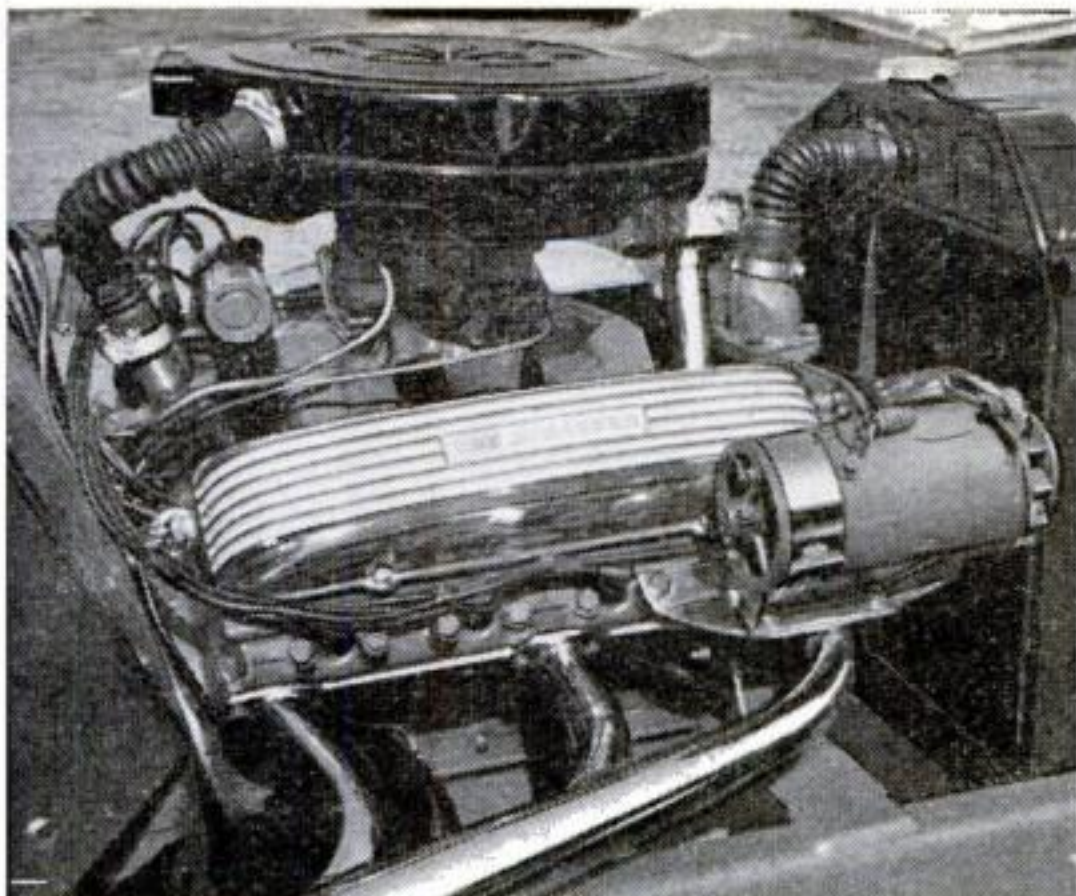
vintage chassis parts, and assorted scrap, cost owner Jerry Huth of Burbank, Calif., only \$660. An auto-muffler manufacturer, Huth built the cherry-red car in two months with help from six assistants.

Credit for the buggy's fantastic traction on loose sand goes to its light weight, its low-pressure tires, and the 300 hp. of the modified engine.

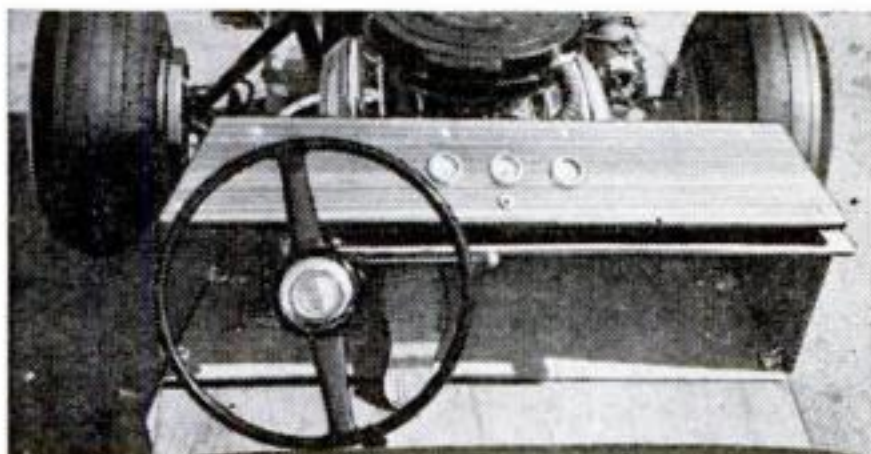


WHEELS are from a 1946 Ford. The rims were split and widened to 12 inches by welding on five inches of pipe casing. Treadless 9.00-

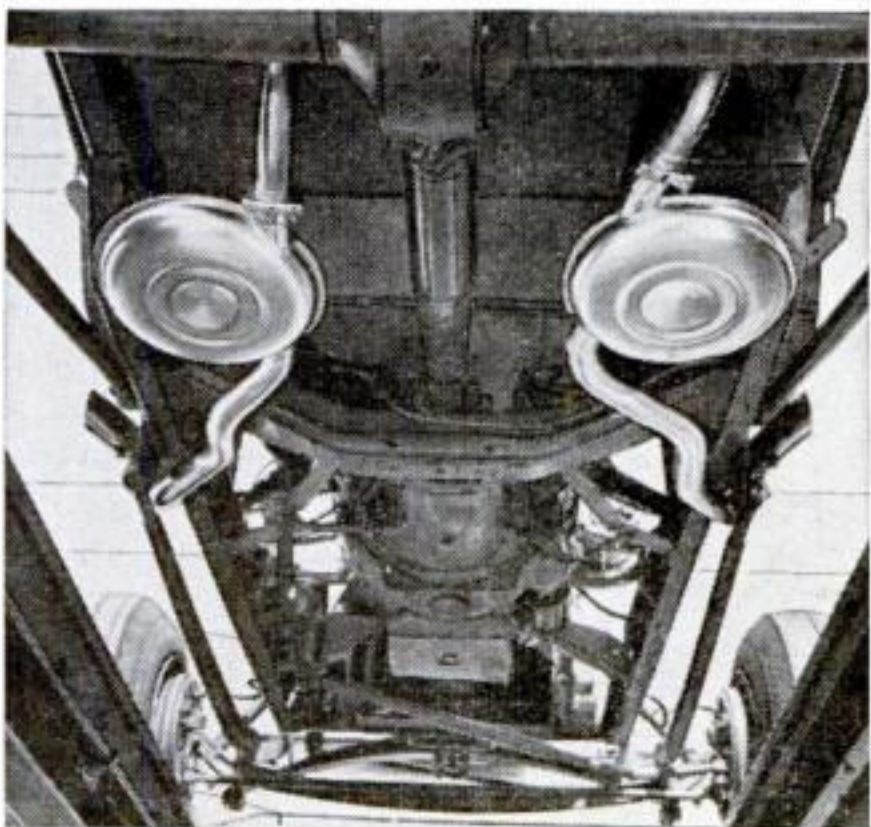
by-15 tires hold six pounds of air. The tailgate is made of plywood and fiber-glass, and the lettering is cut from sheet aluminum.



CADILLAC V-8 boasts overbore, Eldorado cam, four-barrel carburetor, and ribbed chrome valve covers. To keep sand out of the engine, the oil-breather line connects via a rubber hose to a huge Thunderbird air cleaner. A motorcycle breather cap also helps.



IN THE "OFFICE" are a Ford steering wheel, plywood dash, extra gauges, and steel bar.



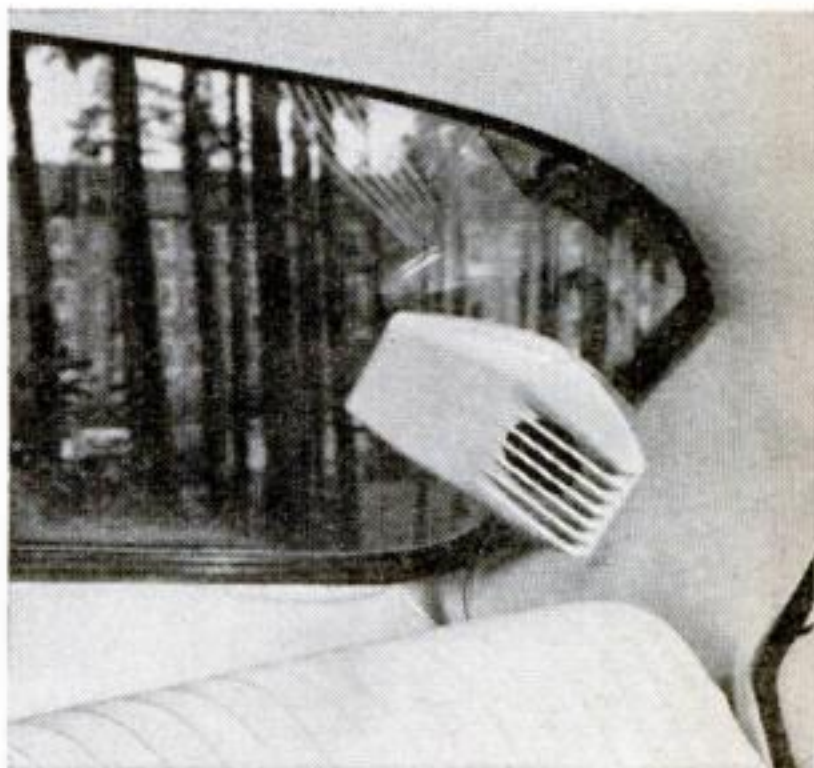
UNIQUE CIRCULAR MUFFLERS were designed by Huth, but aren't being sold yet. Front axle, transmission, rear end are from a 1946 Ford.



Flying ticket seller

A mobile aluminum ticket wagon is used on Eastern Air Lines' hourly pay-on-board shuttle flights between New York, Boston, and Washington.

It's equipped with a locked change drawer, travel credit-card imprinter, tray for forms, and clipboard for passengers signing checks. A foot brake holds it steady in the aisle.

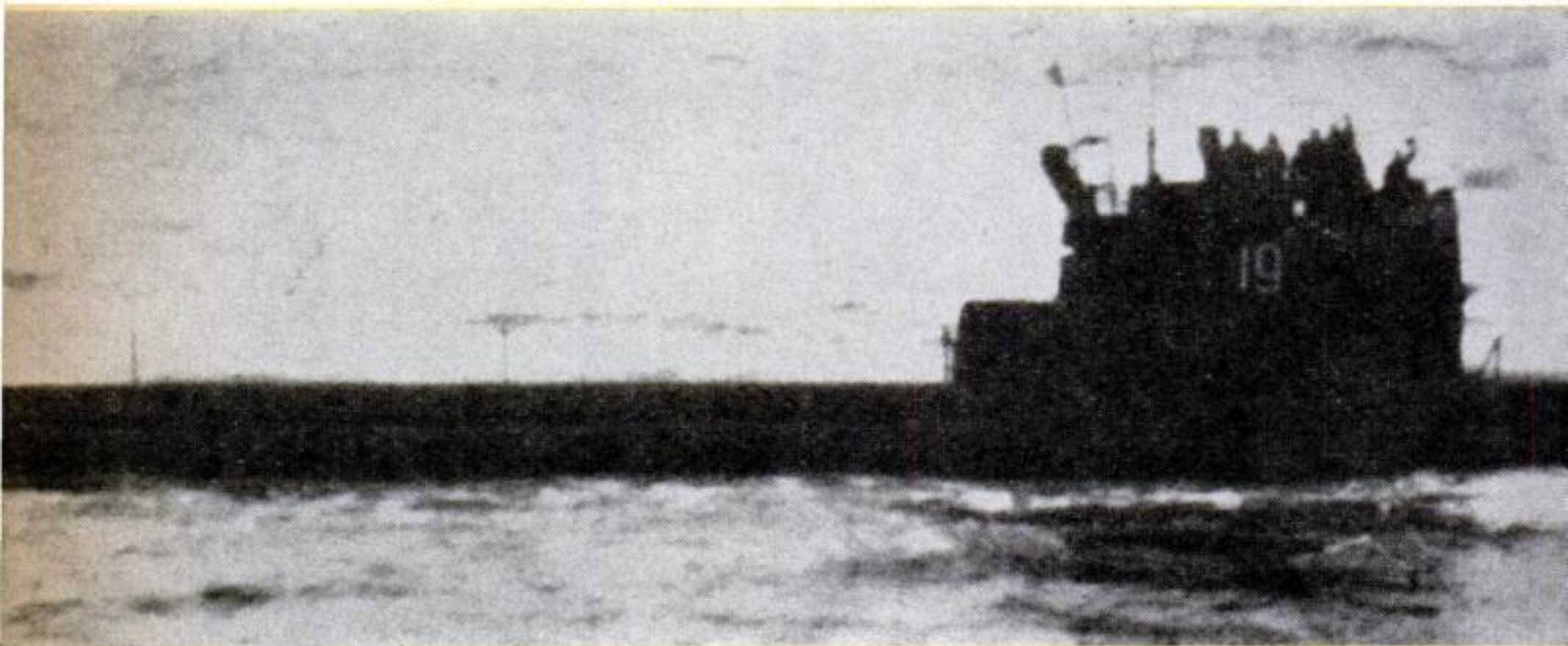


Rear-window defroster

A turboblower held to the glass by suction cups blows a stream of warm air over the rear window of this car to prevent condensation and icing. Rheostat controls on the dashboard regulate output. The Swedish fan has a thermal cutout that trips current should the blower clog. A plastic housing keeps fingers out.

PS EXCLUSIVE:

U.S. Builds Underwater Fence Against Enemy Subs



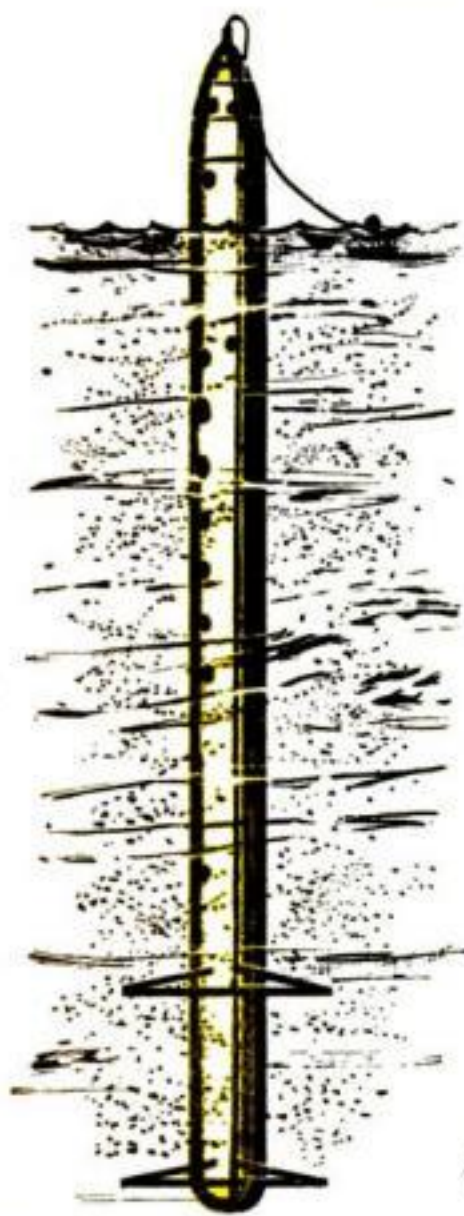
This old W-class boat—caught by Navy recon—is typical of the Russians' huge but

By Martin Mann

THE U.S. Navy is working on one of the biggest and strangest shields ever raised against a dangerous enemy. Or rather, lowered. For this shield would be an underwater DEW line, a gigantic wall of sound waves vibrating through thousands of miles of ocean. Its purpose: to block a new and disturbing menace—H-bomb attack from beneath the sea.

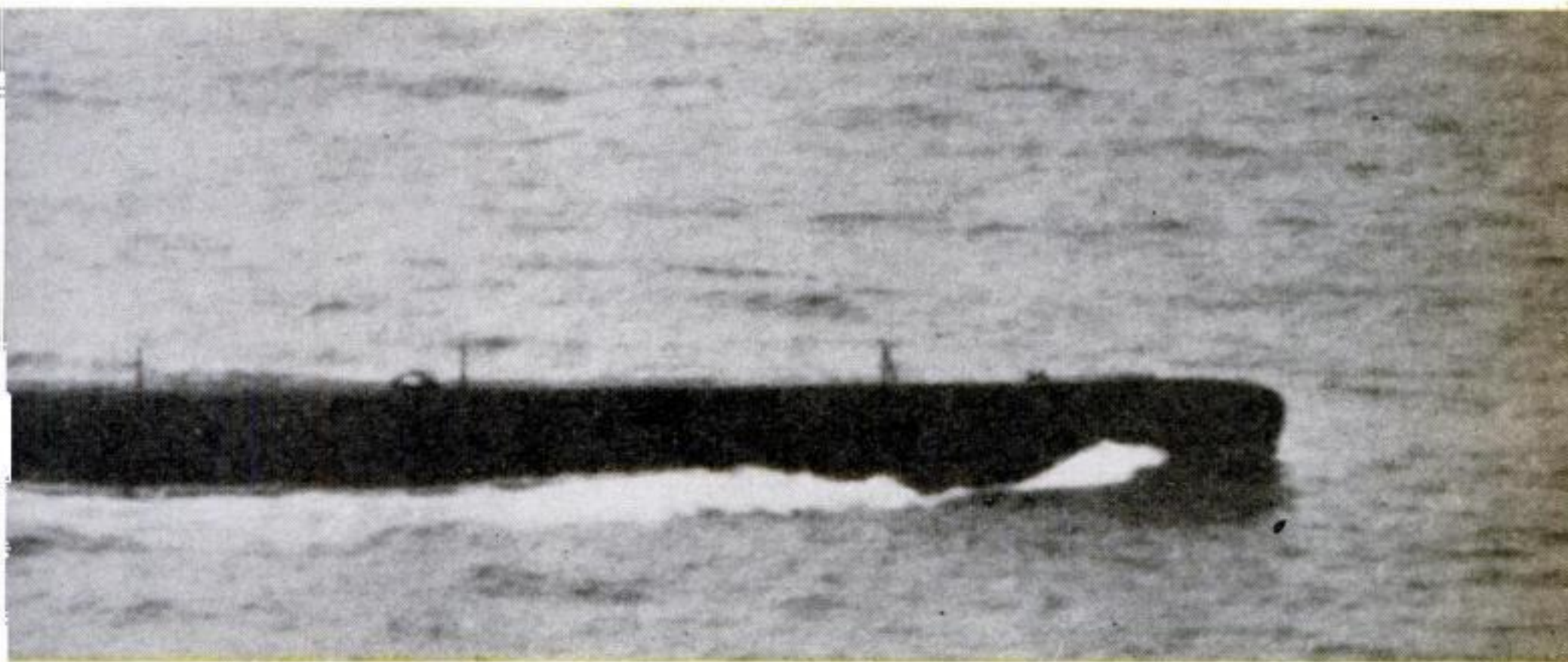
The first test of this fantastic scheme is now going on under the code name Project Artemis. It uses the largest and loudest loudspeaker ever made—a sound generator six stories high weighing 600,000 pounds. There are also a man-made island off Bermuda, secret detectors sunk in the sea, and unspecified miles of cable strung along the ocean bottom. That's just for the test. The full-scale system would multiply this many, many times over.

Details are sealed tight by security. The director of Columbia University's Hudson Laboratory, which runs Project Artemis, won't even talk to reporters. The Navy owns up to the plan only because the machinery is too big to hide.



◀ *Man-made floating islands—such as experimental Spar, 350 feet high, 16 feet in diameter—could carry sound generators.*

Our coastal cities are sitting ducks for H-bomb missiles launched from beneath the sea. The counter: a secret defense network that could flood the ocean with sound waves to spot the most elusive submarines



obsolescent undersea fleet. Modern A-sub's are known to be in the works now.

Still more secret, oddly enough, is an older sub barrier—only slightly less gigantic and costly than its successor Artemis—that has been operating off our coasts for several years. Officially, the Navy will not even admit that there is such a thing.

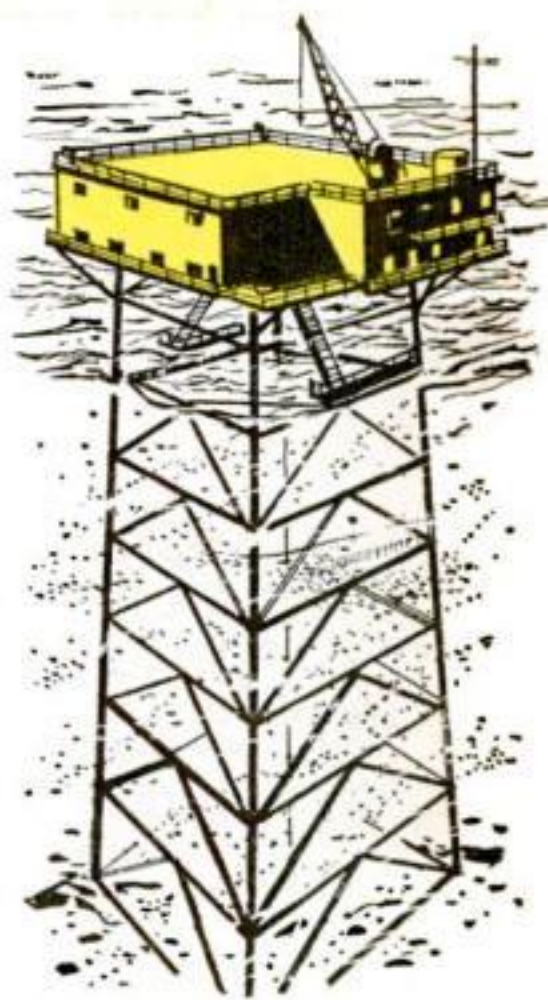
There have been several public references to the old system. These bits of information, combined with official accounts of Artemis and unclassified data on the submarine peril, fill in a revealing picture of a defense effort that may be as vital as our missile offense, yet is almost totally unknown to the public.

Frankenstein's monster. The undersea fence of sound waves now under test is intended to counter a menace that the U.S. itself invented: the Polaris class of submarine. The Russians probably don't have any yet. Their huge sub fleet includes no more than 12 atomic-engined boats equipped to shoot missiles, all primitive compared with the USS George Washington and her sisters. Still, this weapons gap can't last more than a few years.

The Polaris is so formidable because it combines the three most famous inventions of the 20th Century:

The atomic engine gives unlimited range under water and lets the submarine sneak up to the target undetected.

The underwater-fired missile enables the submarine to



Relay station for sound receivers in first test of system is Texas Tower built in sea near Bermuda.

We can handle anything the Russians slip under the sea now.

deliver a big warhead with rifle-like accuracy at medium range (200 to 1,500 miles).

The H-bomb loads the sub-launched missile for a knock-out—one can erase a city or incinerate a small state.

An ironic twist of geography makes the United States more vulnerable than Russia to this monster of the deep. The industrialized population centers of our country are concentrated along the coast, sitting ducks for Polaris attack. The Russian coast is fishing villages and glaciers.

You can see why the admirals worry. They are confident they can handle anything the Communists might slip under the sea this year. (That is, they could win World War II over again.) But they admit they are helpless against good nuclear subs. In fleet exercises, our own "nukes" beat the tar out of our best antisubmarine forces.

First, catch the rabbit. It's no great trick to knock out a submarine, any kind of submarine. We have good guided torpedoes and an atomic depth charge appropriately named Lulu. But you can't kill the sub until you find it. Finding it is so atrociously difficult that the country's best technical brains—a sizable proportion of which are concentrated on this one problem—despair of any real solution.

So long as submarines ran on diesel engines, they had to come up every few hours for air. A snorkel, even a periscope, can be spotted by radar or a sharp-eyed lookout. Nuclear submarines don't have to come up; they can stay submerged for months. Under water they are safe from existing detection systems.

Radar does not go through water. Infrared rays penetrate perhaps a few thousandths of an inch. You can't even see through water more than about 50 feet (no matter how

clear it looks on the *Aquanuts* TV show). These difficulties stem from an unalterable fact of physics: Sea water is a conductor of electricity, and electromagnetic waves—radar, radio, infrared, light—cannot be beamed through a conductor.

What does travel through water is mechanical motion: sound waves. A little old TNT bomb, exploded under water at the right depth, can be heard on the other side of the world.

So one way to find submarines is to listen. Their machinery makes noise that carries clearly through the water.

(Leonardo da Vinci thought of the idea and explained the technique 450 years ago.)

Big wet ears. The secret submarine-warning network that has been defending American coasts the past few years is an electronic-age version of da Vinci's idea. We'll call it Project Z because that is *not* its code name. Although it is



Variable-depth sonar being lowered over stern detects subs hiding under sound-bending layers in ocean.



Copter fingers sub for the kill, dipping sonar (at end of cable) for precise location after the intruder is cornered.

But what happens when they get A Subs as good as ours?

still completely classified, enough hints have been dropped to permit a description that, while no Navy blueprint, is a reasonable facsimile.

Project Z is big. Thousands of miles of cable are strung along the continental shelf. At intervals along the cable are hydrophones — rubber-cased underwater microphones that work exactly like radio-studio microphones. The hydrophones do not lie on the ocean floor, but are buoyed just enough to float a considerable distance above it. That puts them away from sea-bottom noises and in the sofar (sound fixing and ranging) channel. The sofar channel is like an underwater pipe, a region where changing temperatures focus sound waves so that they keep going for long distances.

Sounds picked up by the hydrophones are carried over the cables (which, like telephone cables, include amplifiers) to listening stations on shore. Comparing the loudness of signals from several hydrophones tells where the sound comes from. Some hydrophones are cylinders made up of several independent units that switch on and off in sequence. In effect, this switching rotates the operating, listening ear so that it scans around through 360 degrees to pick out the direction of the sound source.

The listening posts are on offshore islands—Newfoundland, Bermuda, the West Indies, maybe a Texas Tower or two.

There some of the Navy's brightest young men stand watch, ears to phones, eyes to oscilloscopes. It's a double-breasted wonder that even very bright guys can do this job.

Not every rumble in the headset (or every trace on the scope) means a ship. The ocean is as noisy as Times Square on Saturday night. Waves slap, pebbles grind, croakers croak, shrimp snap. From this babble, the hydrophone operator must pick out the rare, faint, and not-very-distinctive sound of a submarine. He's like a blind man, sitting at a window in the Hotel Astor overlooking Times Square, and trying to recognize—by sound alone—the occasional police cruiser that goes by in the flood of taxi, truck, and car traffic.

The oscilloscope helps, by analyzing the signals. There's also a tape recorder to preserve fleeting sounds for careful study or comparison with a tape library of submarine "signatures." Electronic computers are now being enlisted as identification aids. Raytheon, for example, is working on an electronic robot that could learn to recognize sub sounds. It would not be programed in advance for the job (nobody



Navy's standard antisubmarine force—this is Task Group Alfa, led by carrier Valley Forge—is no match for nuclear subs.



Robot helicopter called Dash is new antisub weapon. Its punch: the homing torpedo slung underneath.

[Continued on page 220]



AERIAL TARGET is hurled aloft by George Griffith, Michigan conservationist, as Fred Bear looses arrow toward mark.



CLOSE TO A BULL'S-EYE, the arrow penetrates the whirling target midway in light circle surrounding the dark center.



SPIRAL-FLETCHED ARROWS, called "flu-flus," are used for short-range shooting. If they miss target, they fall to the ground after about 30 yards.

New in archery: skeet shooting with bow and arrow

Archers who like shooting at moving targets may want to try this during the off season. Fred Bear, noted bow hunter who operates an archery factory in Grayling, Mich., calls it wingshooting—a form of skeet or trapshooting with targetlike heavy-cardboard disks taking the place of clay pigeons.

Special arrows used in aerial shooting are called "flu-flus." The feathers are fletched spirally instead of in line with the shaft's axis, increasing wind resistance in flight. This doesn't slow the arrow at close range; but at about 30

yards the arrow loses speed quickly and flutters to the ground. Regular arrows shot into the air may carry a couple of hundred yards—expensive if they're lost, and dangerous.

Right now you'd have to have a helper to whirl the targets skyward. Bear and engineers at his Bear Archery Co. are attempting to perfect a machine to do the job. He is also considering making targets out of such plastics as styrofoam instead of gluing up four thicknesses of corrugated cardboard and cutting on a bandsaw. They'd last longer.



Air-cushion ride for 66 passengers

Largest ground-effect machine is the British Hovercraft at left.

Westland Aircraft's 27-ton SRN2 is powered by four 815-hp. turbines for cruising 200 miles with 66 passengers at a speed of 80 m.p.h.

A military version to carry 100 soldiers with equipment is planned.

New Ideas from the Inventors

.....



Powered Pontoons Steady Boat. Linked to a small boat by pivoted connecting arms, these recently patented outriggers would prevent rocking in rough seas and

provide auxiliary power if the boat's engine failed. The extra power would come from hydraulic pumps fixed to the arms and driven by wave action on pontoons.

Chisel Holder Protects Hands. You could put more power into a sledge hammer if you didn't have to worry about the consequences of a slip. Turning the handle of this adjustable holder would tighten the bight of a cable around the chisel, anchoring it in the V groove, so you could hold it securely—and safely.



Sand Sprays Skidding Wheels. With two sand-filled hoppers like this in the car trunk, you'd be able to fight skids or start up on ice or snow. To give traction to slipping wheels, you'd switch on blowers operated by the battery. They'd shoot a spray of sand through curved pipes opening over the rear tires.



More Inventors' Ideas



"Chandelier" Heats Room. A radiant space heater might be safer for children if it were mounted high on a ceiling instead of low on a wall. To spread warmth downward and outward without adding the bulk of a fan, this inventor would enclose the coil-wound element inside a dish-shaped reflector.



Tire Flattener Foils Thieves. When a car owner locked this clip-on tire valve with a key, it would act like any tire valve. But if he unlocked it when the car was parked, anyone moving the car would get a flat tire: The weighted stem lever would be swung outward by centrifugal force as the wheel rolled.

Rack Becomes Car-Top Seat. You could drive your own grandstand to out-of-the-way spectator events with a luggage carrier like this. Lifted up from the side

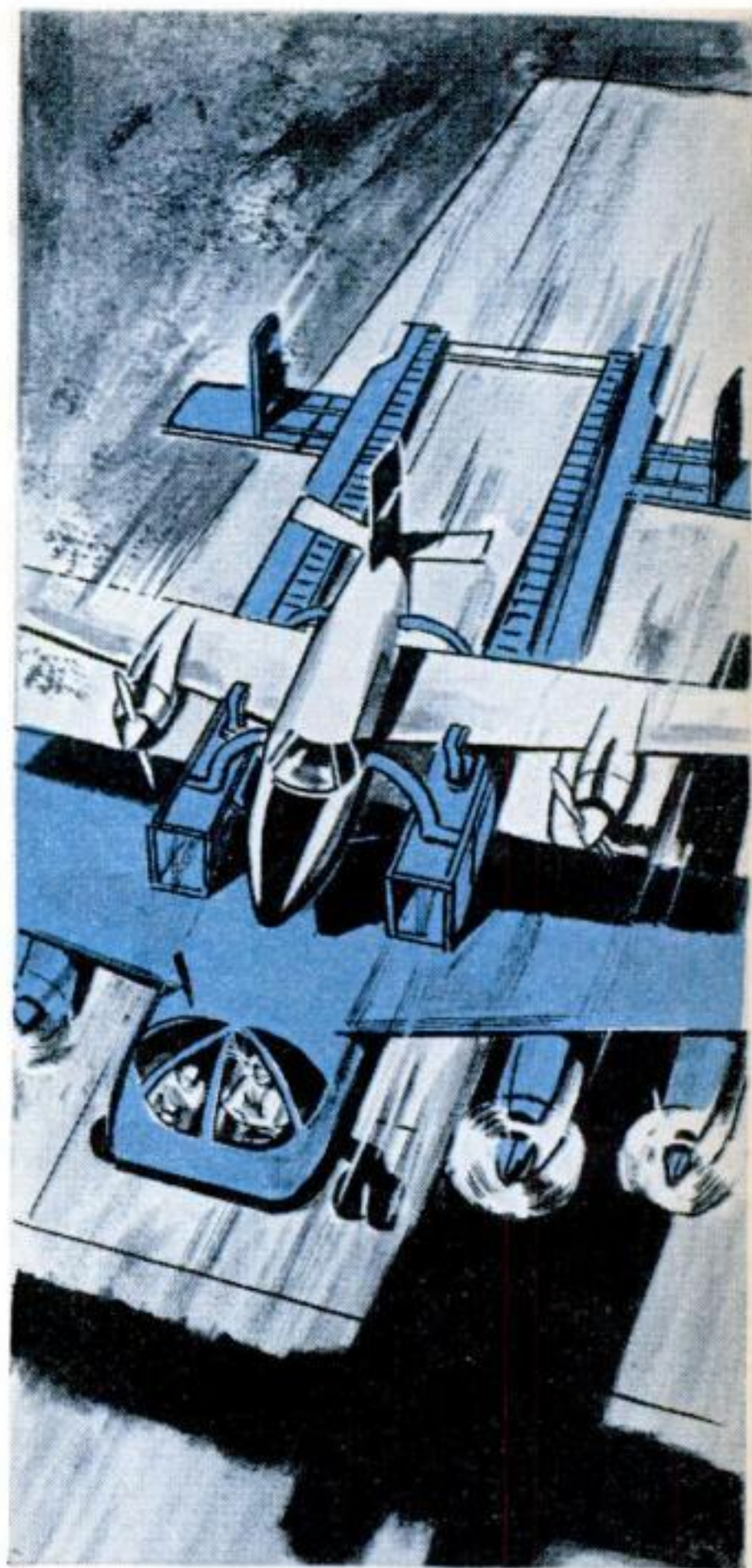
rails, the hinged floor would make two comfortable seats. Folded down, the seats form the floor of a rack for hauling your sports gear or luggage.





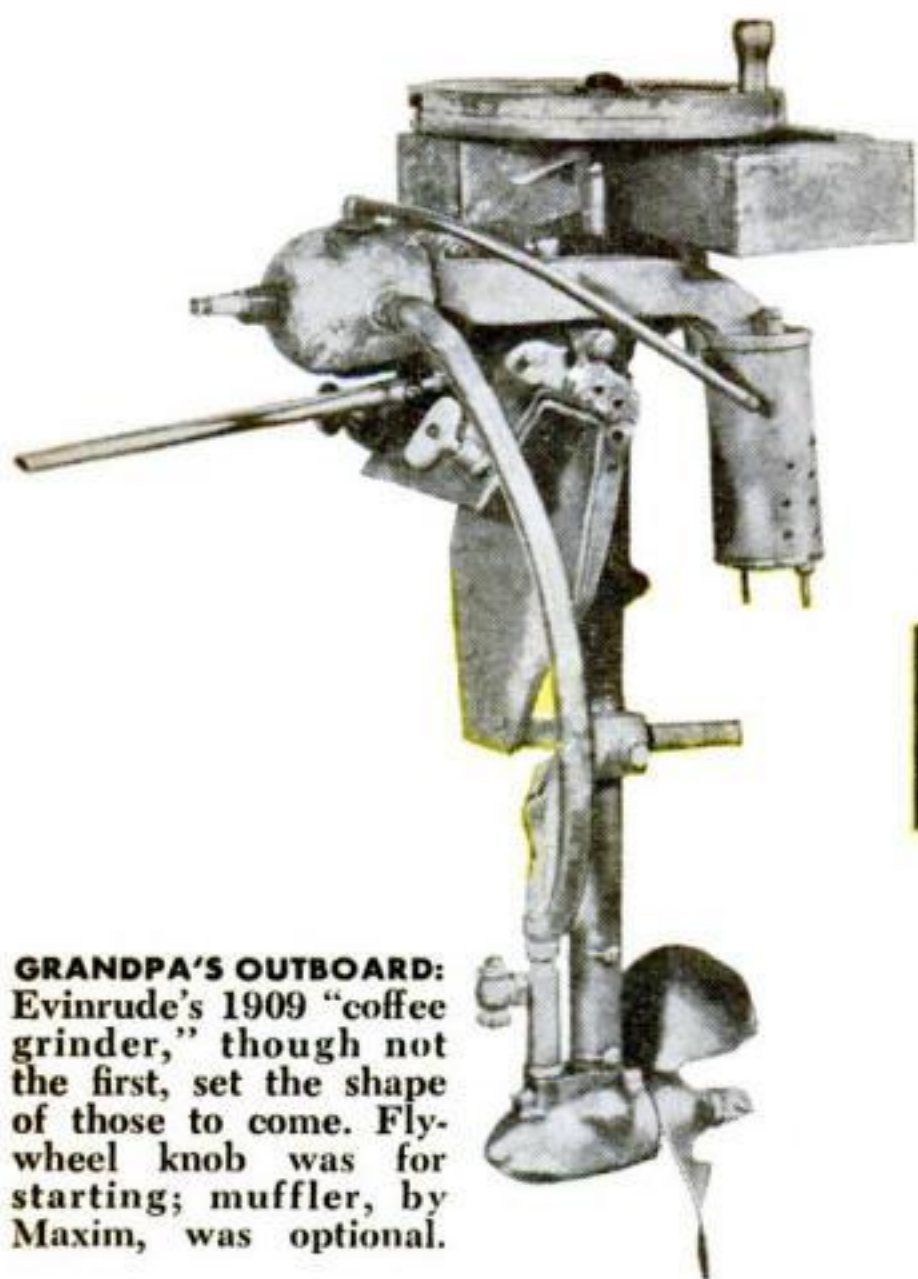
Electric Driver Speeds Nailing. Big carpentry jobs would go a lot faster and easier if you could drive nails at the touch of a switch. You'd just plug this driver into the nearest outlet. A rotating magazine would feed nails to a front opening and a motorized plunger would then hammer each nail home.

Typewriter Folds Into Pocket. For an extra measure of portability, the levers mounting the keys of this typewriter would be pivoted to bend backward. When folded with the keys against the type faces, the tiny machine would be half its open, standard-keyboard size. It could then be fitted into a briefcase, or even into your coat pocket.



Runway Flies to Disabled Plane. Tracks and speed-arresting gear on the back of this flying flat-top is one inventor's answer to "landing" planes in mid-air. It's intended as a rescue runway for small planes with landing-gear trouble or short of the gas needed to reach an open, fog-free airport.

The following patents have been issued on these inventions: **Boat**—No. 3,002,484 to A. T. Dube, Waterbury, Conn.; **Holder**—No. 2,889,726 to C. A. Strabeck, Everett, Wash.; **Sander**—No. 2,999,711 to L. J. Sturmer, Niagara Falls, N. Y.; **Heater**—No. 2,897,337 to R. D. Schiff, Los Angeles; **Tire deflator**—No. 3,003,539 to R. M. Tone, Sunnyvale, Calif.; **Car-top seats**—No. 2,892,481 to J. Seward, Thame, Oxon, Eng.; **Nail driver**—No. 3,004,260 to J. Van Den Elzen, De Pere, Wis.; **Typewriter**—No. 3,001,631 to Marcel Fresard, Geneva, Switzerland; **Runway**—No. 3,003,717 to P. Booker, Riverhead, N. Y. Copies of patents may be ordered, by number, from the Commissioner of Patents, Washington 25, D.C., at 25 cents each. To write to an inventor, if the address given above is insufficient, you may address him (by name and patent number) in care of the Commissioner of Patents.



GRANDPA'S OUTBOARD: Evinrude's 1909 "coffee grinder," though not the first, set the shape of those to come. Fly-wheel knob was for starting; muffler, by Maxim, was optional.

The Smart Engineering Behind the

By Harry Walton

IN POP'S day, the outboard motor was best known for its crankiness. Outboarding was for the intrepid, preferably equipped with a salty vocabulary and a pair of oars. Usually these heroes suffered stiff necks, aching muscles, and weekend deafness.

The two-cycle engine was of dubious—even ugly—reputation. It could be goaded to a bone-shaking 2,400 r.p.m.—if it started at all. Born as a moody, overweight, and abominably noisy infant, the outboard had by the Thirties grown to bumptious adolescence without learning manners.

Today it has changed more than the girl next door. It is cagily engineered, as reliable as your car. It starts up like a beagle at sight of a shotgun. It idles obediently for trolling, races up to a potent 4,500 r.p.m., yet lets you talk in living-room tones above its muted thunder.

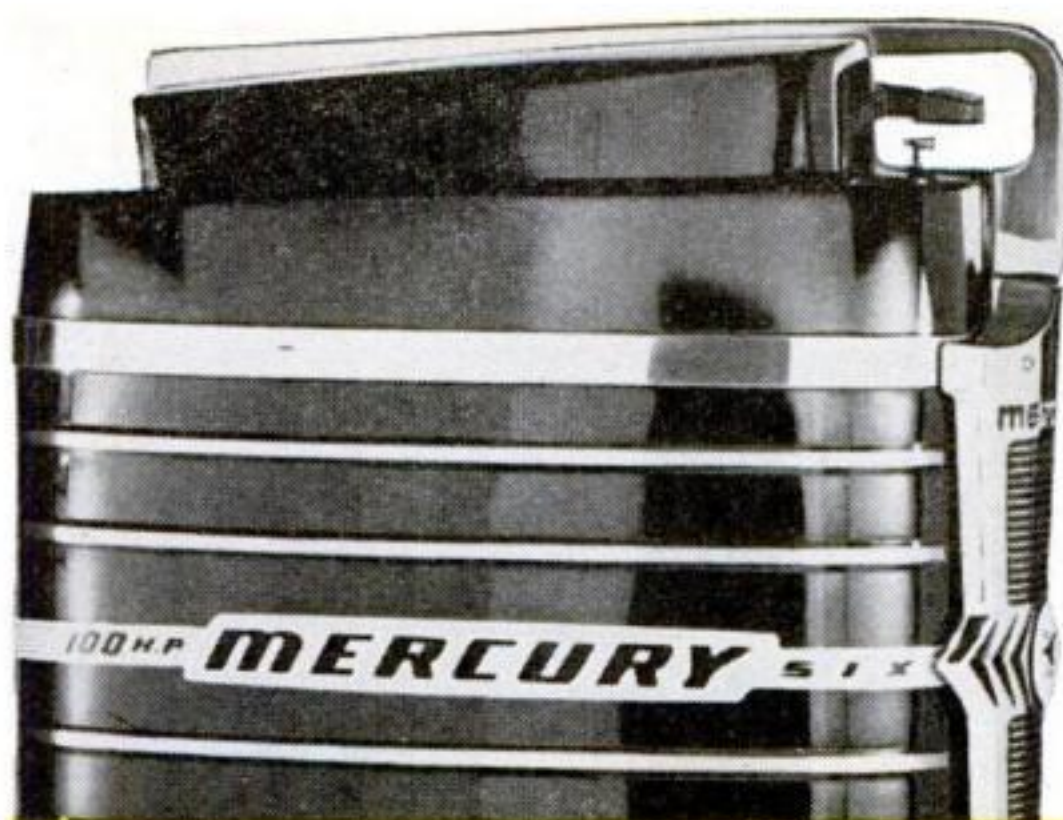
Power is up to a flashing 100 horses in Mercury's newest six this year. Below that are motors to suit every hull and pocketbook—Mercury alone offers

new 85-, 70-, and 25-hp. models to fill the gaps in its already impressive lineup.

Big news from Johnson and Evinrude is an electric shift that does away with dog clutches and control cables, works like silk, and drives through steel. Scott has a revolutionary ignition system with self-cleaning plugs, a self-metering lube system that does away with mixing oil and gas, and hints at oil-less lubrication in the near future.

Here this spring is Scott's new three-cylinder diesel, a high-cost industrial outboard that runs on almost any fuel and outlasts ordinary gas outboards. At the other end of the lineup are a new 28-hp. Evinrude and Merc's new 10-hp. fishing motor. Powerful but docile, these motors would have staggered dad. Hotter ignition, automatic chokes, coordinated controls, and fixed-jet carburetors make even manual starting a cinch. Electric starters, gearshifts, and safety clutches make women and children competent skippers. Today's outboard is for everybody.

The big transformation. What happened to yesterday's mulish two-cycle engines? I asked that of engineers at sev-



TOP OF THE POWER PYRAMID of today's big motors is the 100-hp. Merc 1000. Meant for big runabouts and cruisers, it's a 90-cu.-in. in-line six. Parts are heftier than in maker's size-smaller motors to swing the new higher-pitch props.

'62 OUTBOARDS

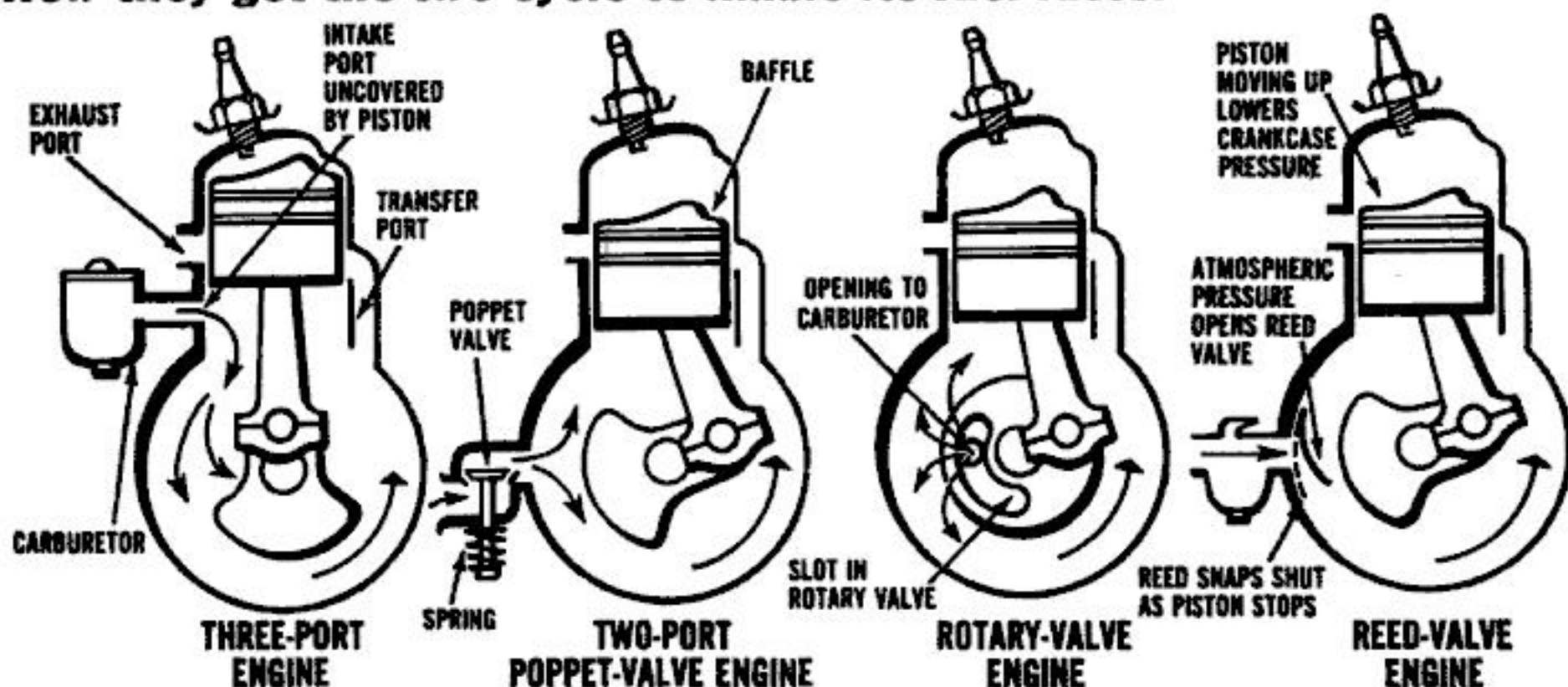


UNDER the sleek hoods of today's high-powered motors is some of the slickest mechanical know-how you ever saw. Here's the first feature of a 35-page special section on boats, motors, and fun afloat for 1962

CONTINUED

III

How they got the two-cycle to inhale its fuel faster



CRANKCASE IS A RESERVOIR that holds the fuel-and-air charge for delivery to the cylinder. All two-cycle engines have an exhaust port, uncovered by the piston on nearing bottom dead center, and a transfer port opposite through which the charge is transferred from crankcase to cylinder. In the old three-port design (above, left) the piston uncovered a third

port near top dead center, letting air from the carburetor into the crankcase. The poppet-valve engine had instead a spring-loaded valve that opened as the ingoing piston lowered crankcase pressure. Rotary-valve engines were positively timed but inflexible to load demands. The reed valve (right) responds instantly to load throughout the speed range.

eral big manufacturing plants. Some of them have sweated over the task for over 30 years.

Like many easy questions, it has complicated answers.

- Better materials helped—aluminum in place of iron, ductile aluminum alloys that can be forged like steel, neoprene and nylon, stainless and chrome-plated steel, new super-strong magnets.

- Making target-plane and chain-saw engines for the military taught designers to wring more muscle out of every pound of weight; demanded the reliability we take for granted but Dad only wished for.

For decades, the two-cycle engine was a stepchild in this country. But Europe advanced it steadily while the U.S.A. was wooing the four-cycle automobile. Deceptively simple, a two-cycle one-lunger has only three moving parts—crankshaft, piston, and rod. But it has griefs peculiarly its own. One is breathing.

At the Outboard Marine plant in Milwaukee, I saw a 1913 Evinrude "coffee grinder." It had a spring-loaded poppet valve to let air into the crankcase when the piston instroke lowered

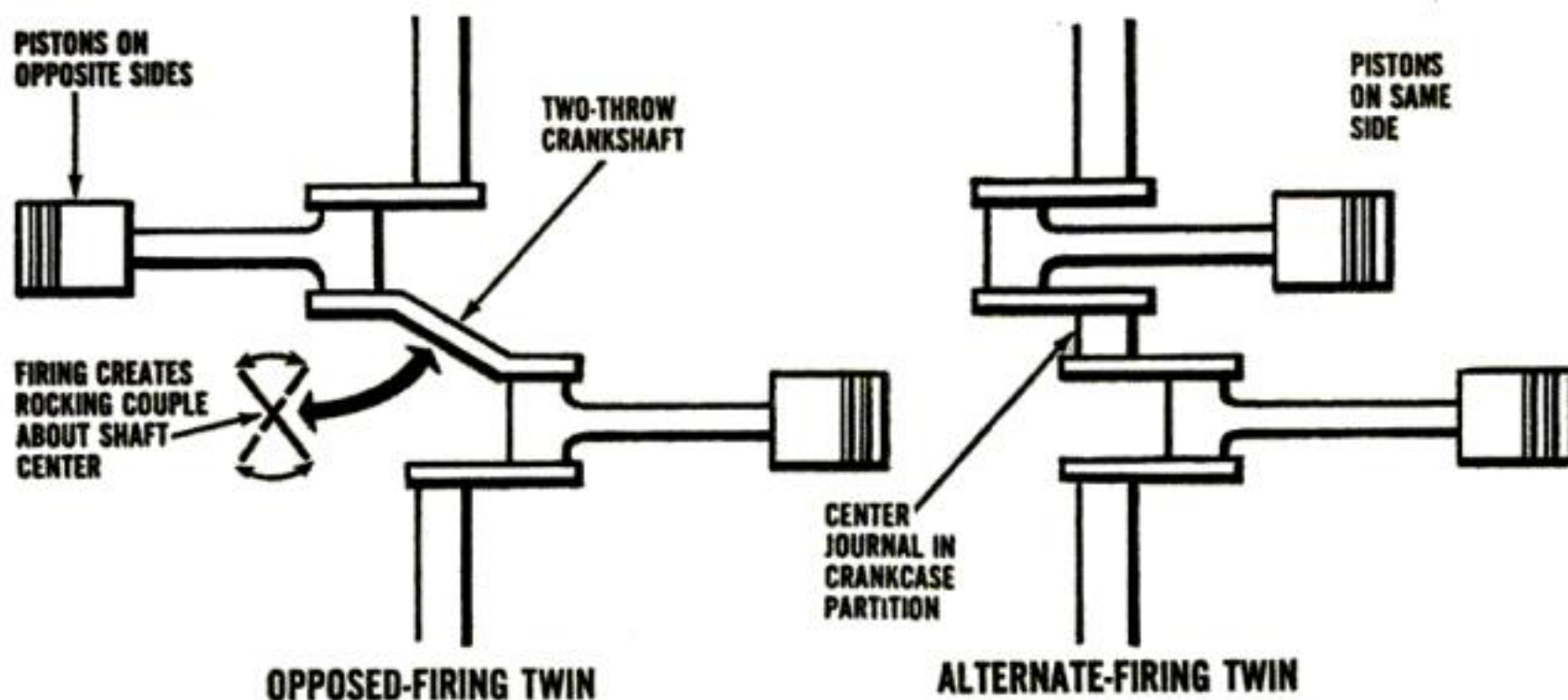
pressure there. The carburetor? A hole drilled in the valve seat.

Nevertheless, this was an improvement over still earlier three-port engines. In these, the piston uncovered a port to the crankcase for a brief instant near top dead center; the charge had scant milliseconds to get in. Poppet-valve engines started and idled better, could breathe easier and work harder. But the valve was noisy and too heavy to keep up with high r.p.m. (Old-timers will remember getting an exhilarating extra 600 revs by leaning on the spring with a daring finger.)

Rotary valves were a natural next step. A hole in the crankshaft or a crank web registered with a stationary one that led to the carburetor. This timed fuel admission to any part of the piston instroke. But a backfire through the rotary valve (which didn't know in from out) could set carburetor and boat ablaze before you could say "women and children first!"

The revolutionary reed valve—a thin flexible strip closing a hole in a plate—hesitantly appeared in the Thirties. Obedient to crankcase suction, it gave

Twin cylinders can fire together or separately



ONCE ALL THE RAGE, opposed-firing twins had a simple two-throw crankshaft in a common crankcase that fed both cylinders simultaneously. Firing together, they developed high torque in proportion to displacement, but the simultaneous push tended to rock the engine around the midpoint of the crankshaft as shown. Today, alternate firing is the rule. A twin

of this type has two distinct crankcase chambers and a sealing journal on the crankshaft between them. Both cylinders are on the same side of the shaft, and as one piston moves up on its compression stroke, the other is firing. The rocking couple present in opposed-firing twins is eliminated, and vibration reduced to a more readily manageable amount.

the engine plenty of time to inhale its inflammables, snapped shut in case of a backfire, and was so lively it could respond at fantastic speeds.

At the Mercury plant in Fond du Lac, Carl Knuth, a technician who was in on the development of Kiekhaefer motors, showed me one of the reed-valve units used in their engines. It is so beautifully machined that you can't find the split that lets it be fitted around the crankshaft. Knuth pointed to stiff curved members over the reeds.

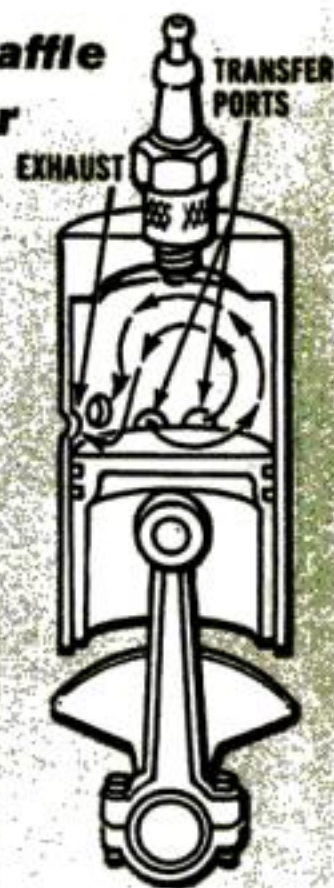
"Flexing thousands of times a minute, the first reeds occasionally broke," he told me. "So Carl Kiekhaefer invented these reed stops. They limit reed curvature, eliminated all but tip breakage."

Like snapping the whip. High-speed photos showed that the up-and-down flip of a reed snapped its tip like the end of a whip. Kiekhaefer overcame that by using Swedish steel of exactly the right thickness, and led the way to universal use of reed valves. In endurance tests, six-cylinder Merc engines have run 50,000 boat miles without one reed failure.

Firing every time around, a two-cycle

Why the piston baffle may yet disappear

LOOP SCAVENGING does away with the piston baffle and complex head shape it entails. Half-section drawing at right shows only one of dual transfer ports through which a fresh charge enters the cylinder as exhaust passes out left side. Incoming flow from two sides sweeps up in twin loops, scavenging and filling the cylinder more efficiently than cross-flow system. Flat-topped piston is less prone to pre-ignition and detonation.



COMPRESSED SHAPE of fuel charge affects spread of the explosion. In new Merc 85- and 100-hp. engines, piston contour squeezes most of fuel-air mix well up into firing chamber.

should deliver twice the power of a same-size four-cycle. Does it?

"That's what we feel the boatman has a right to expect," said Dr. Gordon H. Millar, chief engineer of McCulloch's Scott division. "But as yet we get only 1.8 times four-cycle output. One reason is that port area shortens the effective power stroke. Another is cross-flow scavenging."

Just before the bottom of its working stroke, the piston must uncover a port to let out exhaust gases. A split-instant later another port is opened to admit the fuel-and-air charge from the crankcase. To keep the fresh charge from scooting out after the exhaust, the piston is fitted with a baffle that directs the fresh mix upward, away from the exhaust port directly opposite. This is cross-flow scavenging, simple but inefficient.

Scott hopes, says Dr. Millar, to come nearer doubling four-cycle output by eliminating the baffle. The magic word is "loop scavenging," already used in McCulloch aircraft and chain-saw engines, and in some hot foreign outboards. A flat-topped piston uncovers divided intake or transfer ports each side of the exhaust port. There's a three-dimensional swirl of outbound exhaust and inbound fuel charge that looks like a warped pretzel. But it charges the cylinder more effectively.

Output is already up, in Scott's big 75-hp. three, to 1.19 hp. per cubic inch. "To reach that," said a Scott engineer, "we had to break the pre-ignition barrier that had held us to .9 horsepower."

With a power stroke every revolution, the innards of a two-cycle have less time to cool off between explosions than those of a four-cycle. This makes two-cycle engines, especially big ones, prone to pre-ignition—the firing of the charge by incandescent deposits well before the piston reaches top dead center. Once begun, this explosive kickback makes hot spots still hotter, until you have "runaway pre-ignition." Besides stealing power, this burns or melts pistons, scuffs cylinders, even breaks heads.

Foiling fouling. Scott engineers concluded that high-temperature fouling on spark plugs (which work at 1,700 degrees F., only 200 below pre-ignition temperature) formed the incandescent spots. But colder 1,300-degree plugs oil-fouled at idling speed. Scott put a thermostat in the cooling system, cut the oil mix to 1 in 40, and with Champion's help, designed a new supercold surface-gap plug.

It works at 700 degrees, has a doughnut-like outer electrode almost flush with the porcelain. With a 30,000-volt coil, the spark is so hot it burns off oil deposits at low speeds; but the plug never gets hot enough to form lead fouling. It's practically self-cleaning.

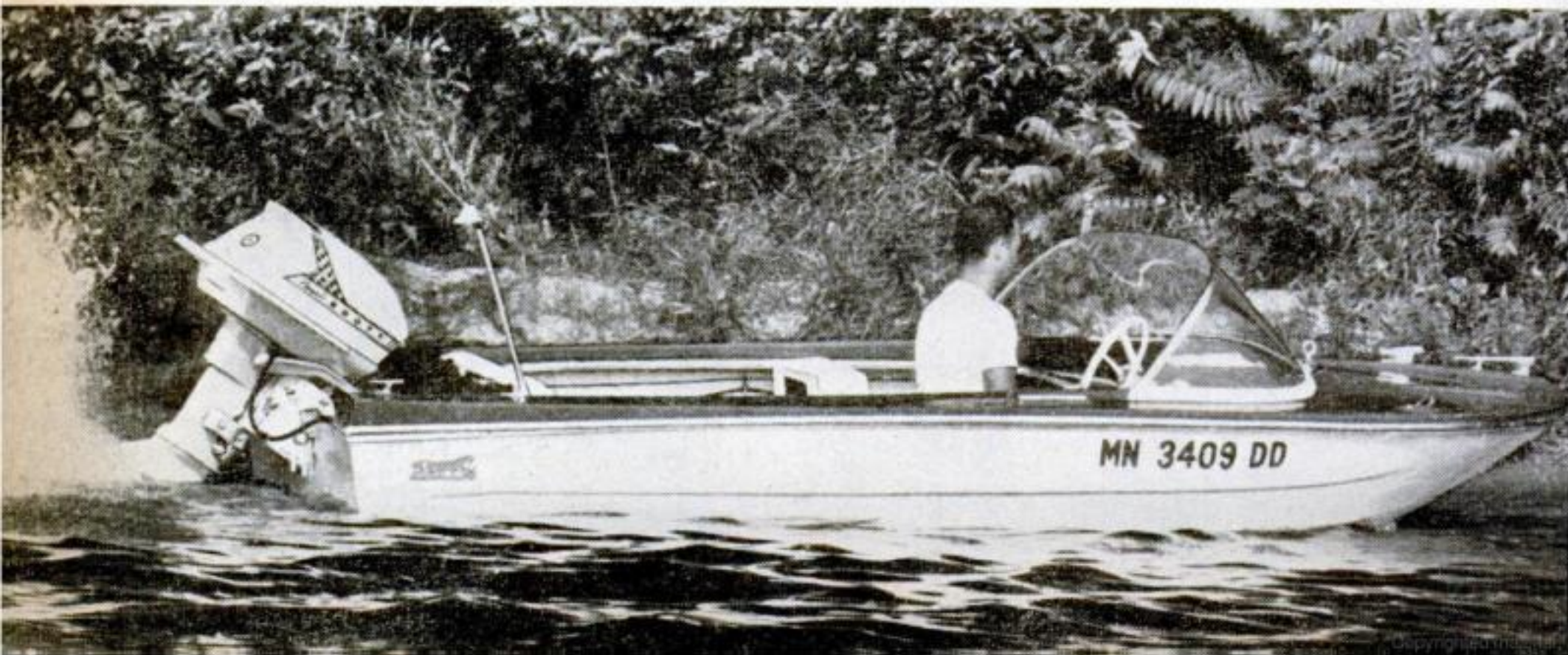
It's amazingly durable, too; the official word is to change plugs once a season, or after 100 hours. Unofficial whispers are that these plugs may outlast the engine.

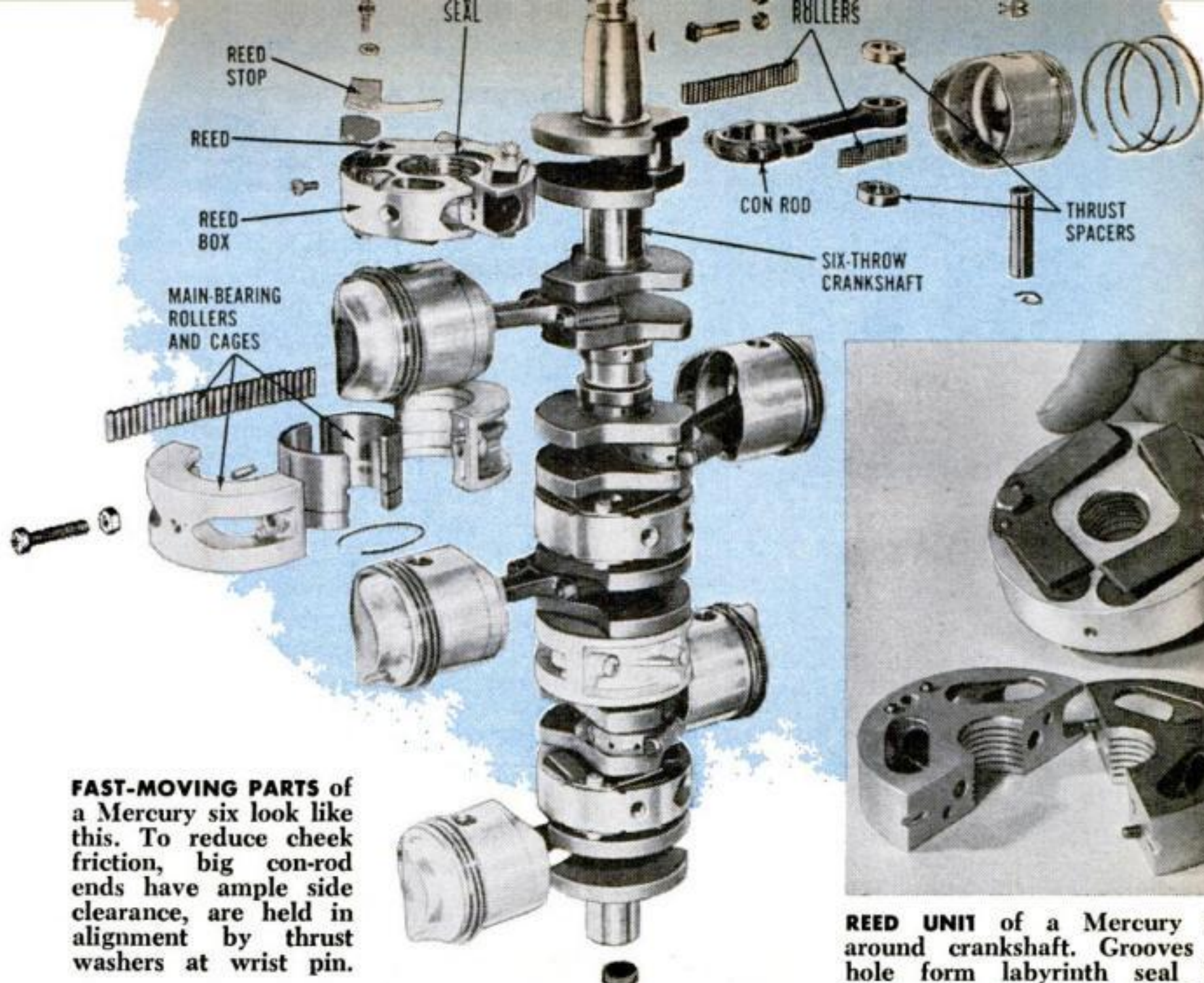
"With pre-ignition licked—and it is," said Dr. Millar. "the next thing to beat is the knock limit."

Knocking out knock. Knock or deto-

OUTBOARDING IN SHALLOWS just deep enough to float the boat is possible with a new tilt mechanism standard on two large Scotts. A release trips the reverse lock, the motor is

reversed until prop thrust raises the lower unit, and it locks into place. The motor can then be run in forward or reverse for trolling, beaching, or running through weeds.



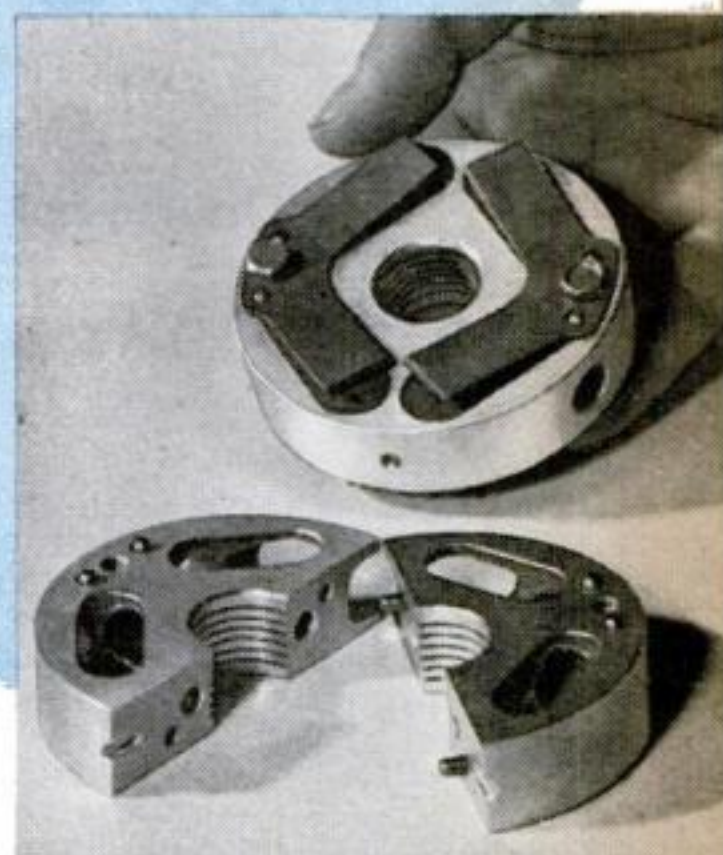


FAST-MOVING PARTS of a Mercury six look like this. To reduce cheek friction, big con-rod ends have ample side clearance, are held in alignment by thrust washers at wrist pin.

nation, slightly different from pre-ignition, is an uneven burning of the fuel charge. Compression ratios (still much lower than in four-cycle engines), piston baffle, and head contour are critical points. The shape of the compressed charge must avoid thin-drawn sections or "gates" that slow down the spread of the explosion, I was told by Scott's Don Endicott.

In big cylinders, the flame has to travel so far from its starting point—the plug—that its pressure wave may trap unburned fuel around the upcoming piston edge and pre-ignite it by compression. Mercury's smaller cylinders, said Carl Knuth, along with piston and cylinder-head contours that squeeze peripheral volume to a minimum, avoid this.

Ball and roller bearings cut friction losses in today's high-speed outboards. Mercury's 10-hp. Lightning of 1947 was the first to have them throughout—Carl Kiekhaefer over-ruled the experts who said needle bearings wouldn't last at the wrist-pin end because it oscillates instead

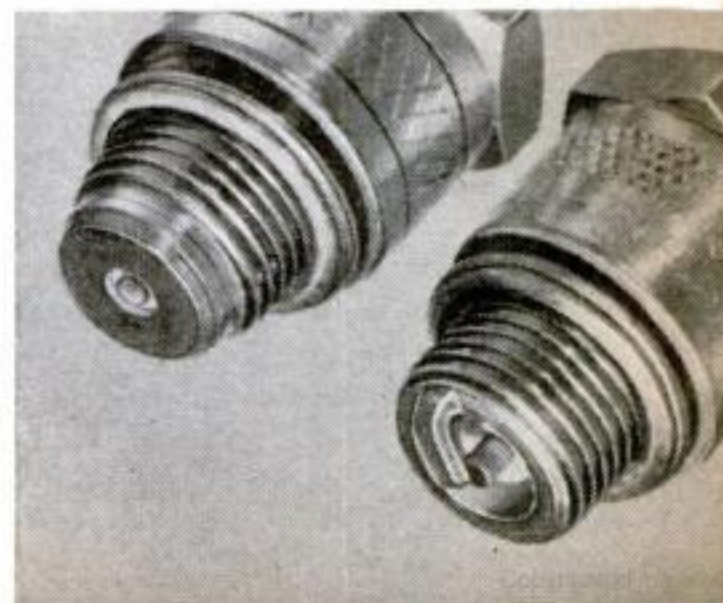


REED UNIT of a Mercury fits around crankshaft. Grooves in hole form labyrinth seal between two crankcase chambers.



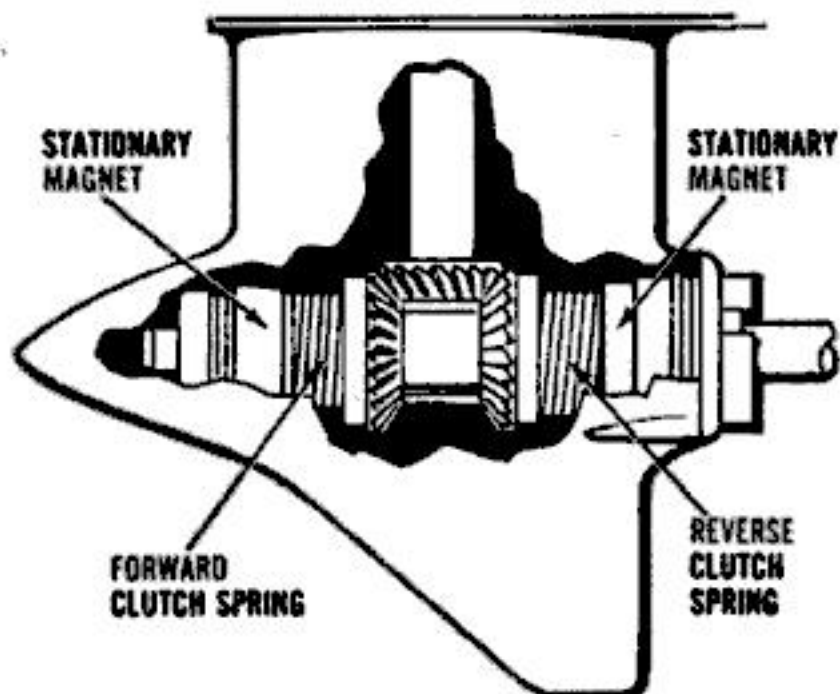
NEEDLE BEARINGS can be seen at wrist-pin end of this rod for a 7½-hp. Scott. Rollers run in steel shells, visible at big end.

NEW COLD PLUG for Scott engines (left) has circular surface gap that won't cause lead fouling. Ordinary plug is shown at right.

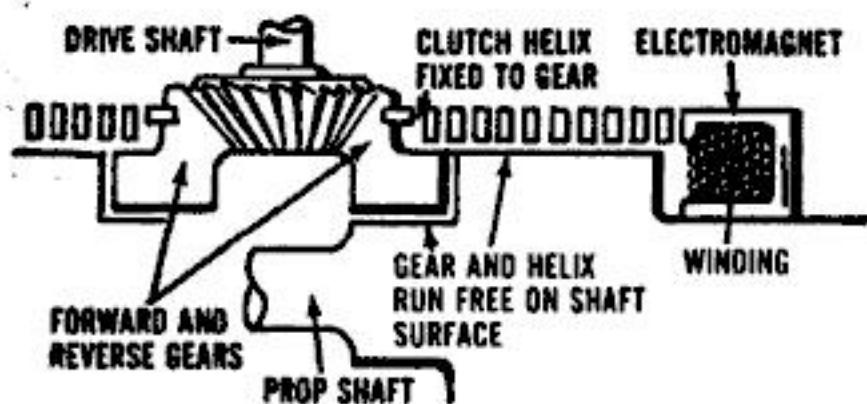


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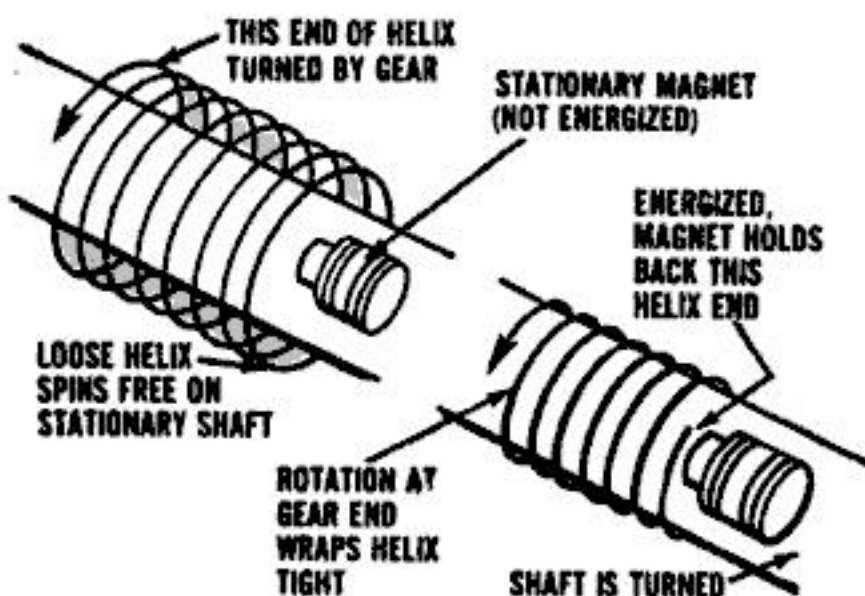
New electric shift gives finger-touch control



BASIC MECHANISM in Outboard Marine's new electric shift has, like others, two free gears on the propeller shaft that turn in opposite directions. But instead of a dog clutch between them, each gear has a spring and ring magnet.



ONE END OF THE SPRING is fastened to the driven gear and turns freely with it on the smooth shaft, transmitting no power. Free end of spring faces a stationary ring electromagnet whose winding is connected to the controls.



WITH MAGNET IDLE, gear and clutch spring spin freely around shaft as at left. When magnet is energized, its drag on loose spring end makes spring tighten on shaft and drive. Engine, not current, supplies the engaging force.

of turning. Today most outboards have them.

Starting her up. Starting the engine has come a long way from the old knuckle-buster knob on the flywheel. The recoil starter that did away with the slow wind-up of a rope looked as if it couldn't be bettered—until Evinrude did just that in '56. An oval (instead of round) drum, keyed so that the pull comes off the wide axis on the compression stroke, gives you maximum leverage.

Electric starting, born in 1930 with a six-volt starter-generator replacing the flywheel, became important as horsepower mounted and women and kids began to operate outboards. Twelve-volt systems appeared, generators were divorced from starters, and in '54, Mercury introduced the alternator, well before it appeared on modern cars (Henry's Model T Ford had it first).

In today's alternators, permanent magnets are set into the flywheel. Stationary field coils are "potted" in plastic, immune to moisture. There's no vulnerable commutator-brush rig; a dry rectifier converts the alternating current to direct for battery charging. Juice is delivered even at idling in some motors through transistorized regulators.

Sparking the motor. Ignition has come around from dry cells to magneto and now, in electric-starting outboards, back to auto-type battery ignition. But the flywheel magneto is still sparking. Hot new magnetic materials make it far more potent at cranking speeds, and spare you the recharging of weak magnets.

Aircraft-style magnetos are driven by flexible cogged belts that maintain timing like rigid gears. In Scott's 75-hp. three, the belt-driven distributor drives a two-ended rotor at half engine speed. Merc sixes have two ignition systems, each firing three cylinders.

Remote gas tanks lighten the transom load and provide greater cruising range. At first they were pressurized by a line from a check valve in the engine crankcase. Pressure pushed gas up a second line to the carburetor—or, if it sprang a leak, sprayed the boat with inflammable liquid.

Now tanks are vented, and fuel is moved by a vacuum pump, the only pressure being in the short line from pump to

[Continued on page 224]



When the owner stepped ashore to phone, two ex-convicts jumped aboard and headed for the Atlantic.

Small-Boat Pirates Are on the Prowl

They'll steal you blind if you give them half a chance.

Here's how you can guard against their pilfering

By E. D. Fales Jr.

A NEW kind of pirate is at large. He's the fellow who boards your boat when you're ashore, swipes motor, tools, and accessories—just about anything that's lying around—or even steals the boat itself.

This modern pirate first appeared in numbers about five years ago—a product of the boat boom. This year, with 7,175,000 glittering craft lying around for the taking in U. S. harbors, boat yards, and back yards, his raids promise to get worse. One trouble is there's no organized campaign against him yet, and no one has solid national statistics. But insurance companies, flooded by claims, say this thieving business is spreading—and something must be done about it.

In some unguarded areas, boat thieves

roam nightly and at will. Until recently, small-boat piracy was confined to certain larger harbors: Chicago, Los Angeles, Boston, Miami, Jacksonville, New York. Smaller inland lakes and rivers were pretty safe.

But last summer, say insurance claims men, widespread thievery broke out in the Illinois "Chain of Lakes" district, and on lakes and rivers in Mississippi and Louisiana. Heavy thefts were reported, too, on boat-crowded eastern lakes, like New Jersey's Hopatcong and Connecticut's Candlewood.

Recently, boats and motors stolen as far inland as Indiana and Ohio have turned up thousands of miles away, in California and Florida. Some stolen motors now are reported being shipped to Canada, Cuba, and South America.

The pirates usually work in pairs,

CONTINUED

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Most pirates are amateur hoods who used to steal cars

though occasionally in larger gangs. In one Eastern harbor, two young thieves recently stole 16 motors in 14 nights. In another, two men boarded a cruiser and chain-hoisted a heavy Chrysler engine right out of the hull—in plain view of other boat owners—and hauled it away.

This sort of thing can cost you plenty—especially if you're one of the six in ten owners who aren't insured. Even if you are insured, you're being hurt: Insurance a few years back cost only \$20-



The car seemed heavily loaded, and the cop investigated. There were three outboards in the trunk.

30 per \$1,000. This year you may pay \$60. On a \$3,000 boat, your premium has jumped from, say, \$90 to \$180.

Nor is the end in sight. Some insurance companies now consider outboards bad risks—and may go out of the business. In a few pirate-infested harbors, certain companies refuse to write policies on any boat—outboard or inboard.

What can you do about it? To decide, you should know how the pirates work.

Who are they?

Some are hardened pros. But most are amateurs—hoods who used to steal cars but now find boats more diverting. The pirates first concentrated on small craft: dinghies, skiffs, and outboard hulls that could be toted away.

Then they found that a boat is hard to sell. So they turned to motors, unclamping them from transoms and hauling them away by boat or car. In one area, this traffic was discovered only recently by a cop who stopped a car at two a. m.—for running a red light. The car seemed heavily loaded, and the cop

investigated. There were three outboards in the trunk.

More recently the thieves discovered accessories. Insurance men say the haul in 1961 ran into millions of dollars. Favorite plunder: fuel cans (\$23), cushions (\$5-10), pilot and fishing chairs (\$50-300), anchors, chronometers, binoculars, cameras.

How they work

They have a number of sneaky tricks. At Stamford, Conn., harbor patrolman Ed Black spotted a man in an outboard going fast toward shallow water. Curious, he checked again a bit later. This time the boat was being rowed. The motor was gone.

Investigating, Black found the boat had been stolen. The oarsman, to avoid suspicion, had run into shoal water, dumped the motor, and was planning to return after dark to retrieve it.

In one Eastern boat yard, a thief casually wandered among boats stealing tools—especially power sanders. One by one he dropped them over a fence into tall weeds—to be picked up by a confederate with a car.

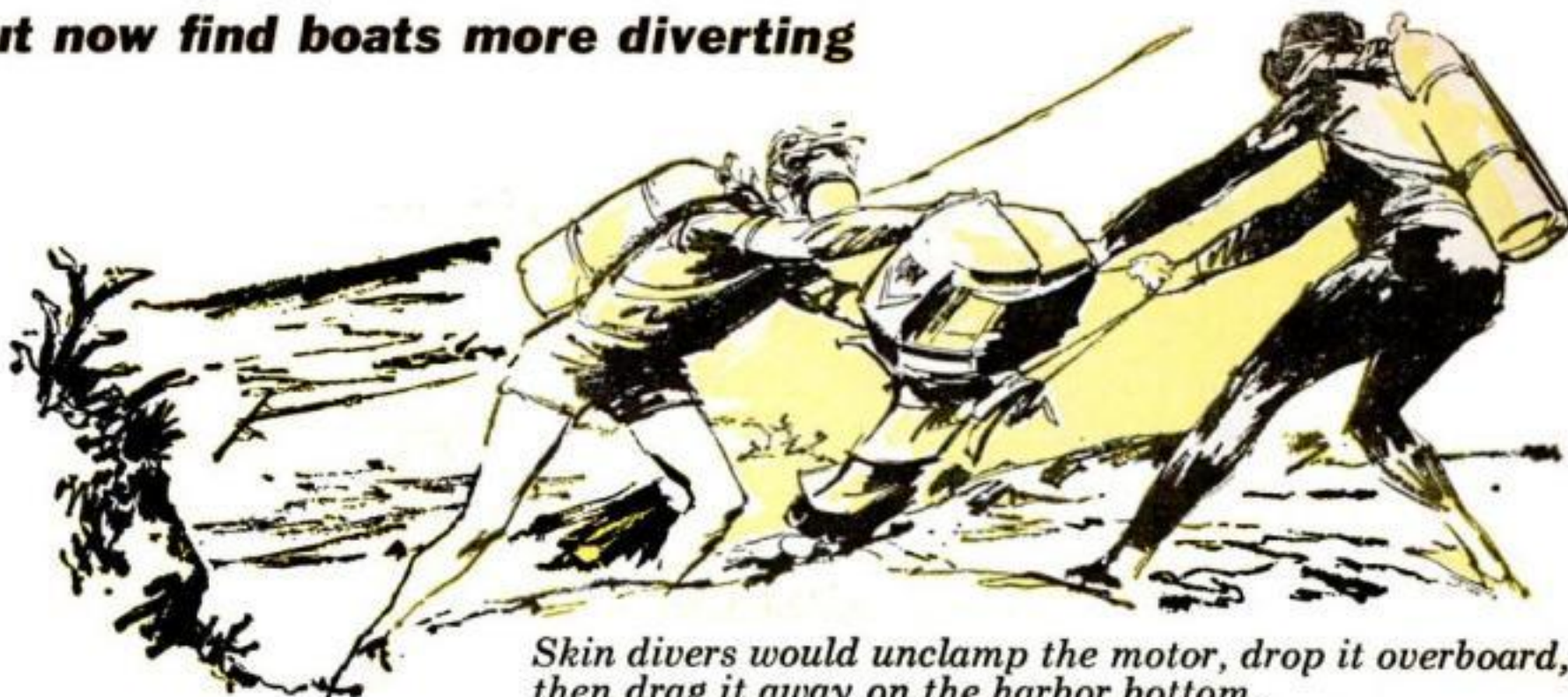
In Florida, one gang took up skin diving. They would swim under water, quietly board a boat, unclamp the motor, and drop it overboard. Then they'd dive in and drag it away, unseen, on the harbor bottom.

At a big Eastern outboard meet, a different kind of gang arrived at the regatta grounds by truck. In plain view of hundreds, they hoisted motors aboard and drove away unmolested. Said a spectator later, "I thought they were mechanics."



The gang arrived by truck and, in plain view of hundreds, hoisted motors aboard and drove away unmolested.

but now find boats more diverting



Skin divers would unclamp the motor, drop it overboard, then drag it away on the harbor bottom.

Near Chicago, according to the Coast Guard Auxiliary, pirates now are "stealing to order." A gang may get an "order" for valuable equipment—say a \$500 ship-to-shore radiophone. When a boat is spotted that has such gear, a thief is put aboard. He dismantles the radiophone and is picked up later.

In Sheepshead Bay, alert New York harbor policemen even found one gang cruising in a launch, dropping off a thief at a time on each of several promising-looking boats, then returning later to pick up man and loot.

Some pirates are amazingly brash. In Gerritsen Channel, Long Island, N.Y., a \$30,000 cruiser came in from sea. When the owner stepped ashore to phone, two ex-convicts jumped aboard, started the motors, and headed for the Atlantic Ocean. Only the daring of two harbor patrolmen, who drove a small unmarked pursuit craft across a dangerous reef in fog to intercept them, saved this yacht for its owner.

Not even back yards are immune. In Wisconsin, an owner left his cruiser and trailer in his driveway. Next time he looked, both were gone. In Connecticut, thieves stole an 18-footer from the yard of a policeman. It turned up, two years later, being used by a cottager on a lake in New York State—sold to him by two men who had said: "We need to raise money to get home from our vacation."

According to the Coast Guard, many stolen boats are never recovered. Reason: So many look alike. With motors, it's different. Many are recovered, thanks to repairmen who now keep long

lists of serial numbers of stolen motors, issued each month by manufacturers. (Johnson and Evinrude pay dealers \$10 for each stolen motor detected.)

What can you do?

Advises the Coast Guard: Avoid lonely, unlighted moorings and storage areas. If a well-guarded marina or club area is not available, haul your boat home and lock it in your garage. Leave as few valuables as possible in your boat.

It's important, in high-piracy areas, to have an all-night caretaker. In a bad area near New York, one marina has had only two small thefts in seven years. The owner attributes it to the fact that he sleeps at the marina and has an open intercom to his room to monitor any sounds or voices. "And besides that," he boasts, "I have two watchdogs."

To make it harder for thieves, some patrols recommend sheathed chain or cable instead of mooring lines that can easily be cut.

"Chain can be cut, too," says Lt. John Fox of the Coast Guard's big New London, Conn., base. "But thieves won't risk the time or trouble. You'd be surprised how many thieves panic and abandon a job when even a small problem is thrown in their way."

How else can you foil the pirates? Here are further suggestions by experts.

- Hidden electrical switches have proved so effective that even some police boats now use them.

- Hidden fuel valves are effective, too. One night recently two men stole a

[Continued on page 228]



Airboats skim on surface of shallow water

Air props on boats at left can't foul in mud or marine growth.

The Aircat in the top photo is an all-fiber-glass catamaran with 65- or 85-hp. Continental engine or 125-hp. Lycoming. Sizes: 12 $\frac{3}{4}$ and 14 $\frac{3}{4}$ feet. \$1,895 to \$2,795. Hurricane Fiber Glass Products, Box 93, Cypress Gardens, Fla.

McBride Air-Thrust "outboard" (bottom) fits most boats. With 2 $\frac{1}{2}$ -hp. engine, 18-inch prop is \$249; 24-inch, \$339. Controlled Airstreams, Inc., 1734 W. El Segundo Blvd., Gardena, Calif.



ALL-PLASTIC SIDE-WHEELER designed for small fry is hand-propelled by independent four-blade paddle wheels at the sides. A bucket seat open at front lets its young pilot's legs hang through and aid stability. Pad'l Boat's hull is molded of unsinkable Dow polystyrene foam like that in life belts and rafts. Price, \$15.95. A. T. S. Enterprises, Inc., 66 Ritch St., San Francisco.



PREFABRICATED PORTABLE PIER has $\frac{3}{4}$ -inch marine-plywood deck in 3 $\frac{1}{3}$ -by-8-foot interconnecting units. Steel-rod supports are rustproof, can be put up with tool that comes in kit. Standard is for depths up to five feet, with others available. DocKit Pier sells for \$125 in single units, \$120 each for two to five, \$115 for six or more. Pasconi Systems, Inc., Box 173, Cambridge, Mass.

.....WHAT'S NEW in Boating



CAMPER-SLEEPER-BOAT is two-wheel fiber-glass trailer with sleeping compartment for two inside and entrance through side door. Tailgate drops down to serve as work table and expose kitchenette containing stove, icebox, and storage for groceries. Nested on top is an eight-foot fiber-glass boat. Cost, \$895. Trailorboat Engineering Co., 923 Francisco Blvd., San Rafael, Calif.



UNSINKABLE PRAM has nine-foot hull of foam sandwiched in fiber-glass. It's so buoyant it floats half-full, but you can drain it by pulling a plug. "Squall" rowboat is \$395; sailboat, with sail, \$595. Nautical Engineering Corp., West St., Fall River, Mass.



FLAG BUOY warns other boats to keep away when you are skin-diving below. Its 36-inch mast and 12-inch weighted keel telescope into 6-inch-diameter float for carrying. Plastic, \$9.95; copper, \$14.95. Safety Float Corp., 35 S. 5 St., Waterbury, Conn.



FLOATING PADDLE has a seamless blade made of Olin hollow aluminum plate, inflated hydraulically and filled with urethane foam. It won't sink, splinter, or warp, is less than half the weight of spruce. \$9.95. Norton Mfg. Co., 2335 W. St. Paul Ave., Chicago.

CONTINUED



FISHING FLOAT is vinyl-coated nylon bosun's chair held up by inflated truck inner tube. You wear waterproof, chest-high waders, put legs through seat, and walk and swim out to fishing grounds. Paddle Pusher sells for \$23.95; inner tube is extra. Fishmaster Mfg. Co., 825 N. Portland St., Oklahoma City.



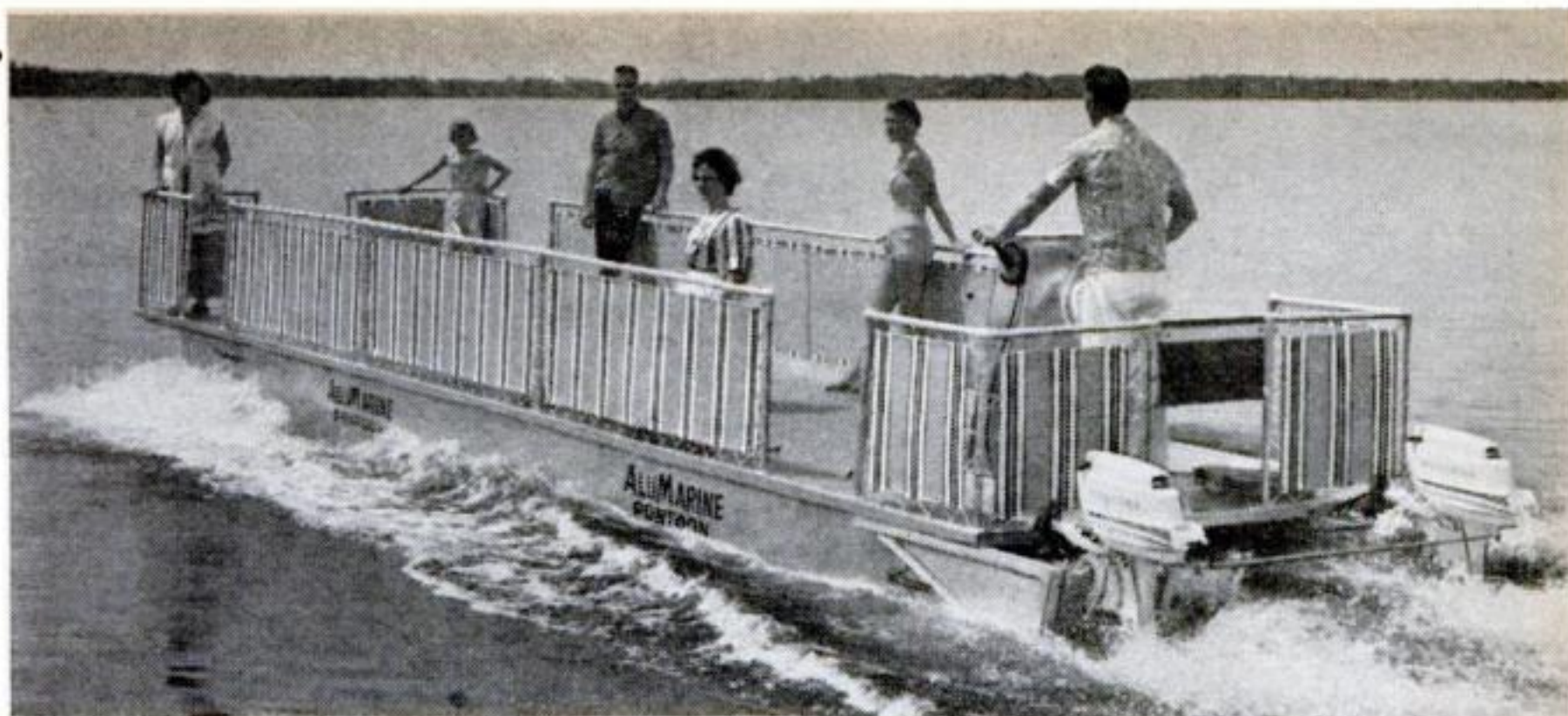
COLLAPSIBLE CATAMARAN is mounted on inflatable nylon-and-vinyl pontoons. Cockpit is fiber-glass on tubular-aluminum frame. With pontoons deflated and spray shield folded, it measures 11-by-45-by-50 inches. Water Cat I seating three is \$249; for five, \$289. Domestic Film Products Corp., Millersburg, Ohio.



CRUISER "HARDTOP" provides cover for rear deck when you want to keep out of sun or rain. Made of aluminum over tubular-steel frame, canopy weighs 200 pounds, most of it in glass windows. It slides forward on flat rails atop reinforced gunwales for fishing over sides. Cost is about \$300, depending on size of boat. MacDonald Camper Kits, 16827 Foothill Blvd., San Leandro, Calif.



OUTBOARD GRILL enables you to broil steaks and barbecue over charcoal without danger of fire. Broiler is equipped with tubular arm that fits in a flagstaff socket. It hangs over the water when you are cooking, swings inboard for serving, and out again to carry the heat away from the diners. With flagstaff socket, it sells for \$33.95. Aqua Bar-B-Que Corp., Box 202, Melrose, Mass.

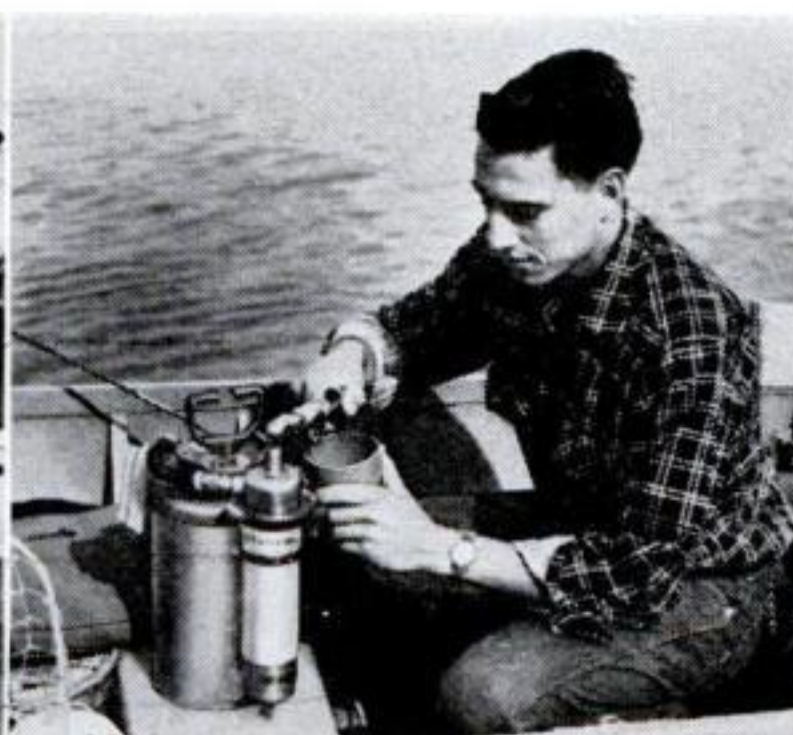
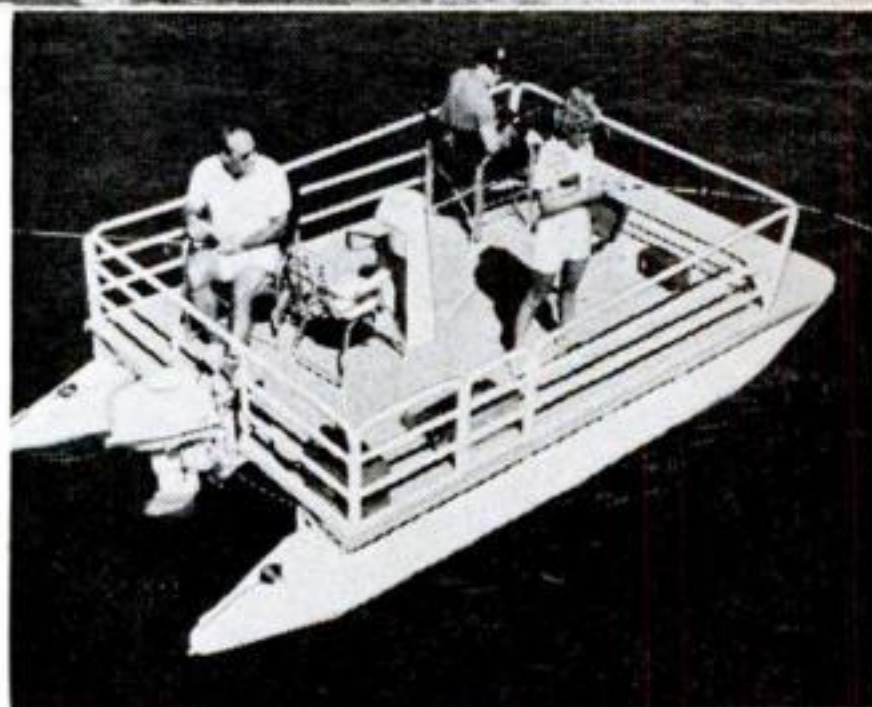


Flat-top pontoon cruiser you can build or buy

These plywood-decked pontoons carry no superstructure to snarl fishing lines.

Maker of Mercury outboards sells parts for 8-by-30-foot boat above: 15- to 26-foot pontoons, \$160 to \$365 each; prows, \$65 each; steering wheel and attachments, \$63.70; helm station, \$30; twin motor mounts, \$45, and single, \$30. Kiekhaefer Corp., Fond du Lac, Wis.

Ready-made 8-by-13 footer at right, \$475. Kayot, Inc., Mankato, Minn.



PORTABLE FILTER AND PURIFIER removes bacteria and pollution, gives you clear, pure drinking water from lakes, ponds, streams, and rivers. Dynitron Sportsman consists of rustproof stainless-steel tank, pressure pump, and a filter element. Fill tank, force water through filter with a few quick strokes of pump, and fresh, germ-free water, with obnoxious odor and taste removed, will flow through faucet. Purifier weighs less than 10 pounds, takes little room in car or boat. Price, \$99. American Dynion Water, Inc., Lowell, Mass.



FLOATING BASKETBALL is latest water sport for youngsters. Basket floats on ring of polyethylene foam, bobs up and down on ripples and waves to make scoring a feat. Ball is tough plastic. Set costs \$8. Argo Industries Corp., 200 Fifth Ave., NYC.

Here Come Water Karts



1 JOHN ROGERS' AQUA-KART

Two home-built baby inboards—powered by tiny kart

2 JOHN MOLL'S HYDRO-KART



By Sheldon M. Gallagher

EVER watch a high-speed racing boat slam along in a shimmering rooster-tail plume—and get the itch to try one? Two men who did have come up with a brand-new idea in water sports: miniature inboard racers powered by the same little roaring, high-revving one-lung engines used in the currently booming karting craze. Their remarkable charm: easy installation, low cost, and the use of standard, readily obtainable kart parts.

One boat, built by John Rogers of Texas, is the nearest thing to a regular land kart with its wheels removed and a prop hooked on instead. Only 8' long, it's powered by a McCulloch MC-10 of approximately 6½ hp., a popular kart engine. Drive sprockets, chain, steering wheel, gas tank, and swank seat upholstery are all stock kart accessories. Even the prop-shaft bearing—normally a specialized fitting—is simply a standard rear-axle bearing from a kart.

Another racer, designed by John Moll of Bellevue, Wash., is actually a sporty, scaled-down version of the great Gold Cup hydroplanes, complete with twin sponsons and rakish tail fin. It's slightly longer—10' 4"—and is powered by a 6½-hp. Power Products AH 82, another widely used

kart mill. Both boats have hit up to 25 m.p.h.—docile enough for youngsters yet brisk enough for adventurous dads. Both are well-named: Rogers', the "Aqua-Kart"; Moll's, the "Hydro-Kart."

What the boats are like. Rogers and Moll do not agree on all points—part of the fun of pioneering a new idea. Moll reverses standard hydroplane practice by putting the driver ahead of the engine. This, he contends, keeps heat, noise, and fumes behind the driver and is also safer if anything should suddenly let go.

In the shorter Rogers' boat, it was necessary to move the engine ahead of the driver—a reverse twist on karting practice—in or-

der to get a sufficient run for the angled prop shaft. This has the advantage, however, of making the engine easily accessible from the cockpit. With Moll's rear-

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engines—are the first in a red-hot new water sport



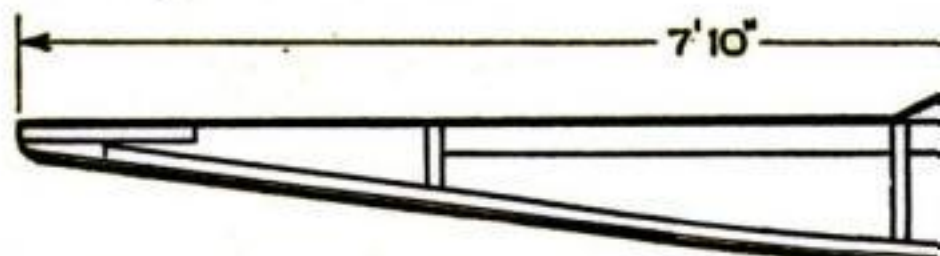
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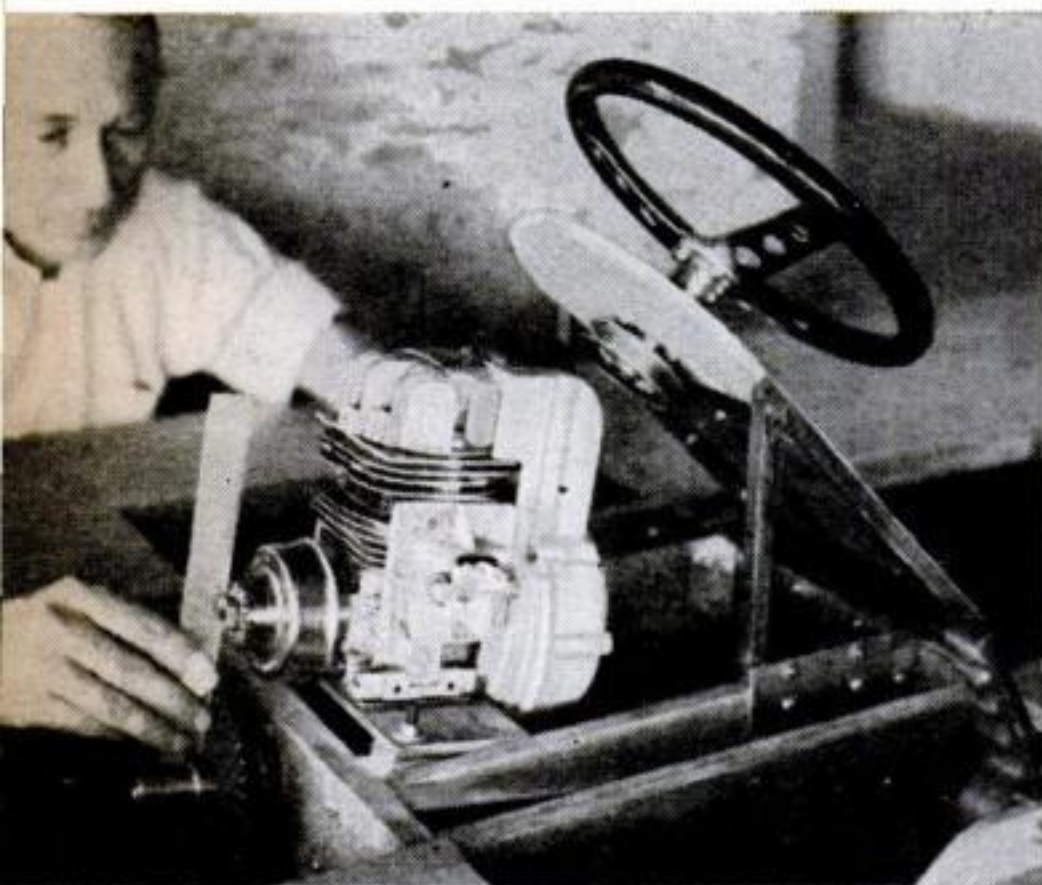
SHEET-METAL NOSE COWL is left partly open at sides for access to engine and starter. Note racing-type throttle to left of steering wheel, gas tank tucked behind seat. Small kart trailer is ideal for toting water karts, too.

1 DETAILS OF THE AQUA-KART

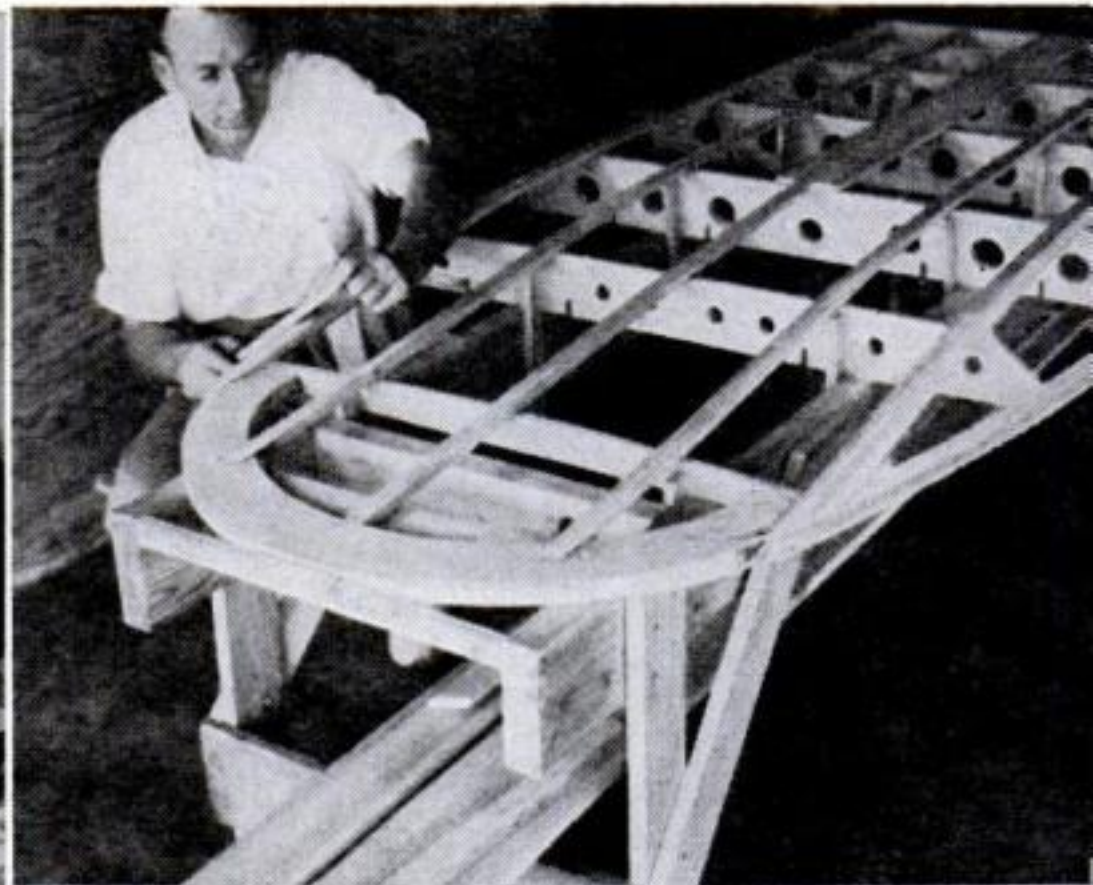


How You Can Get Working Plans

Detailed plans for the wood-frame Aqua-Kart shown here can be obtained for \$5 a set from John Rogers, 5511 Gaston Ave., Dallas, Tex.

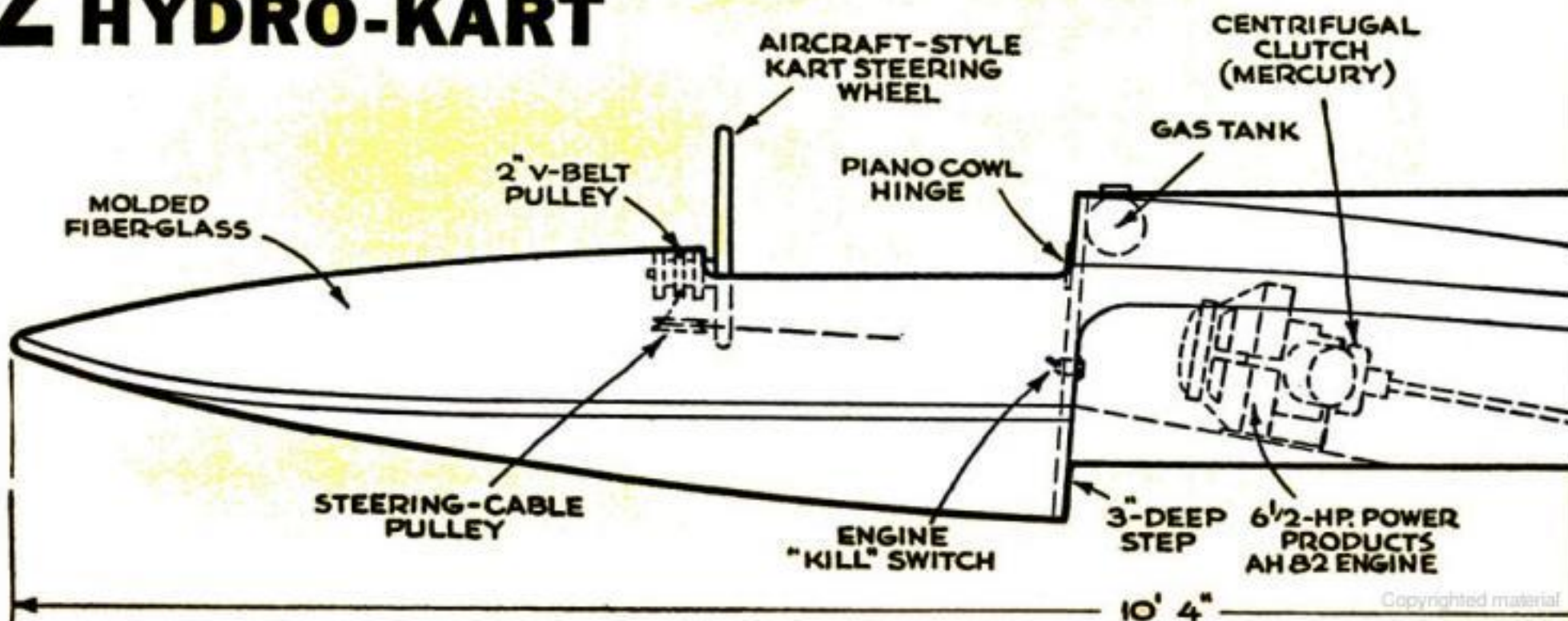


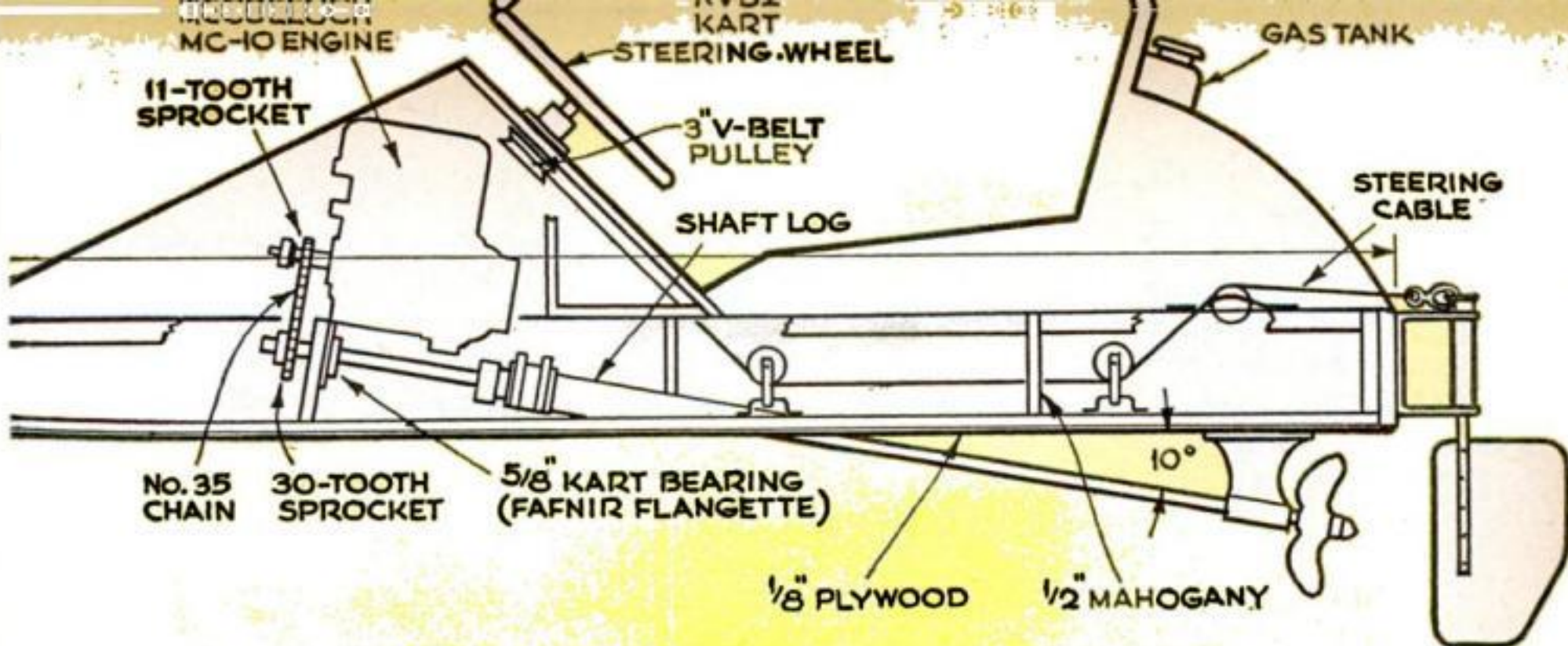
ROGERS' FRONT ENGINE, with small sprocket, is mounted above large sprocket on prop shaft at matching 10-degree slant. Sprockets must line up precisely to prevent chain drag. Note V-belt pulley used as steering-cable drum.



LIGHTWEIGHT FRAME is made of 1/2" mahogany to take thin plywood skin. Jig is recommended to locate rib stations accurately. Semicircular bow block is made by laminating short curved sections into single, double-thick unit.

2 DETAILS OF THE HYDRO-KART





engine design, it was necessary to extend the starting rope through the firewall behind the seat to make it accessible from the cockpit.

Moll, a believer in simplicity, forsakes frills. There are no chains, belts, pulleys, or gearbox. All of the engine's 6,500 r.p.m. are coupled directly to a small, high-revving prop. Rogers uses a chain drive, with an 11-tooth sprocket on the engine and a 30-tooth on the prop shaft to give about a 3 : 1 reduction. This is desirable on the powerful McCulloch engine, he reports, and gives you freedom to experiment with various drive ratios.

Moll's only concession to gadgetry is a centrifugal clutch to make starting easier without load. Rogers has tried both ways and doubts if a clutch is needed on a geared-down prop. In any case, a clutch gives you, in effect, a neutral gear and is handy if you want to idle your engine before getting aboard. Otherwise, you're off the second you pull the starting rope.

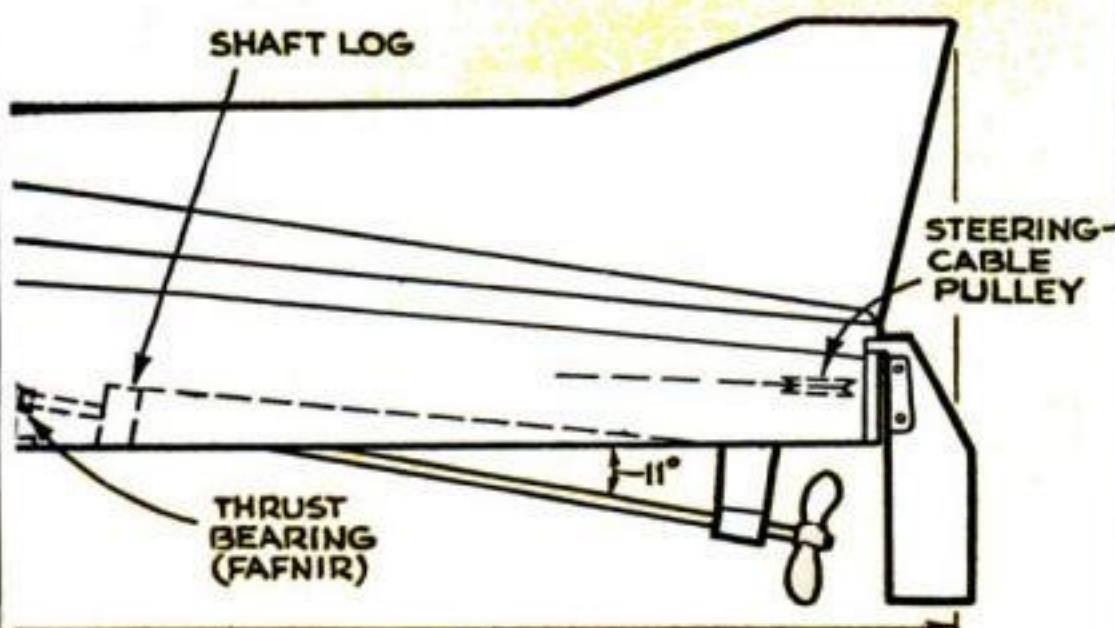
How the hulls compare. Moll chose a stepped design that looks like a Gold Cup three-pointer except that the step runs continuously from sponson to sponson. The prototype hull shown here is

CONTINUED

MOLL'S REAR ENGINE drives prop shaft directly, is concealed by hinged, drop-down cowl cover. Air scoops keep engine cool; exhaust is piped out through transom.

You Can Also Get Plans for the Moll Hydro-Kart

Full working plans for a wood-frame version of the Hydro-Kart are available for \$5 from John Moll, 16239 Lake Hills Blvd., Bellevue, Wash.



slick, hand-molded fiber-glass—a luxury touch that Moll frankly doesn't recommend for anyone wanting to get a hull in the water fast. He's currently designing a simpler wood-frame version.

Rogers' boat is a wood-frame hydroplane, similar to the little outboard types except that the step has been eliminated. This simplifies construction and does not affect performance, he maintains, at the present modest speeds. The forward-mounted engine balances the hull nicely so that it planes well without a step.

Because of limited power from the little kart engines, it's necessary to keep the hull as light as possible. Moll's lightweight fiber-glass design weighs only 150 pounds, but may go a bit heavier in the wood-frame version. Rogers uses $\frac{1}{2}$ " mahogany for his frame, covered with a thin skin of $\frac{1}{8}$ " exterior-grade plywood. Maximum beam width is 42". Moll's beam is 48" across the sponsons, but slims to 28" at the engine well. Both racers will carry payloads of up to 180 pounds.

Rudders on both boats are controlled by steel tiller cables, as on conventional outboards. An interesting departure, however, is the use of an ordinary V-belt pulley on the steering shaft to carry the cable instead of a special, more expensive drum. Steering ratios are fast, as on karts, permitting showy, exciting turns and slides. Moll's aircraft-style steering wheel makes only a half turn from lock to lock.

What do they cost? Depending on the engine you pick, you can put a water kart together for \$200 to \$350—about the price of a good land kart. The only strictly nautical requirements: a propeller and a shaft log and stern strut to support the shaft. The angle the shaft log makes with the bottom of the hull will determine the angle at which the engine must be mounted to line up with the prop. Rogers' engine is canted 10 degrees off horizontal, Moll's 11 degrees.

Both designers have experimented with various outboard props and small Class A racing props. Rogers' current favorite is a $5\frac{1}{2}$ "-diameter two-blader with a $7\frac{1}{4}$ " pitch. Moll uses a 7" two-blader with a lower 6" pitch because it must spin faster without gear reduction.

In choosing an engine, you must be sure that its shaft rotation matches prop rotation. Rogers' forward-facing engine must turn the opposite way from Moll's rear drive. Depending on prop and drive arrangement, it may be necessary to use a reversed, or "mirror-image," kart engine.

With the Moll direct drive, it's also necessary to use a thrust bearing in line with the engine since kart mills aren't designed to take end loads on their crankshafts. In the Rogers chain drive, there is no end load on the engine itself, and thrust is taken by the kart-axle bearing on the prop shaft. Both shafts are $\frac{5}{8}$ " in diameter and can be bronze or Monel.

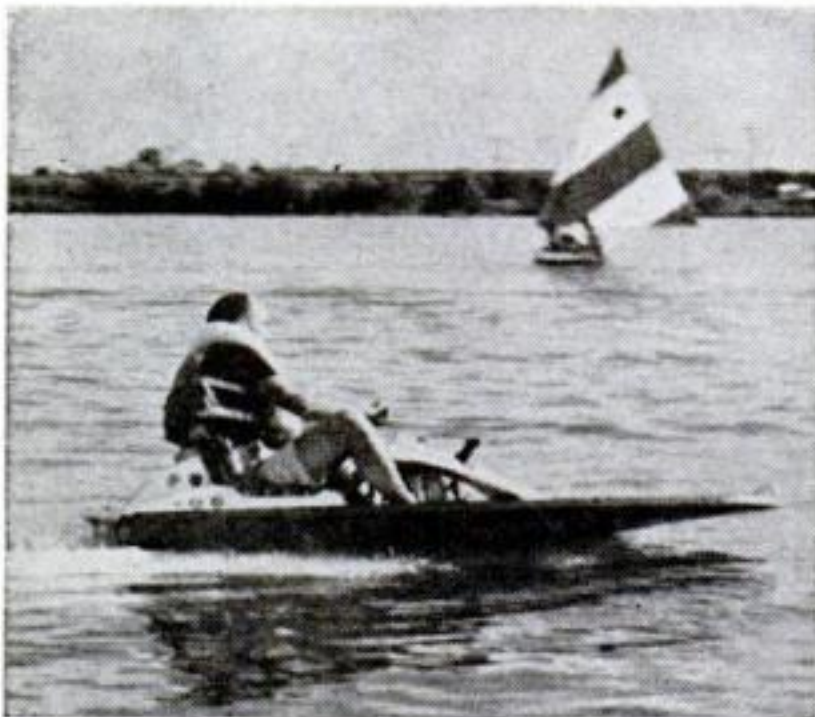
Both boats have a "kill" switch in the cockpit for quick shutoff of power.

A whole new sport. Both designers expect water karts to gain nation-wide popularity just as land karts have. Why? "They're actually more flexible," says Moll, "offer more opportunities for experimentation and ingenuity, look more realistic in scaled-down form than their wheeled cousins, and give the same breath-taking thrills and fun."

Moreover, present speeds are only a beginning. Huskier engines and hull refinements will send them skyrocketing, just as they have in land karts. Already, a twin-engine version—borrowed right from the karters—is being planned.

Moll would like to see karting clubs grow up in each community and even has plans for a kart rink where nearby water facilities aren't available. "It would be a shallow pool only 15" deep and about 160 by 300 feet. You could race 20 to 30 water karts at a time on a rink this size and have a whale of a time."

And we'll just bet you could. ■ ■



Roger's Aqua-Kart hits a brisk 25 m.p.h.



CONTROLLED AREA
RESTRICTED
AS INDICATED



INFORMATION
DIRECTIONS,
SUPPLIES, ETC.

DANGER
BOATS
KEEP OUT

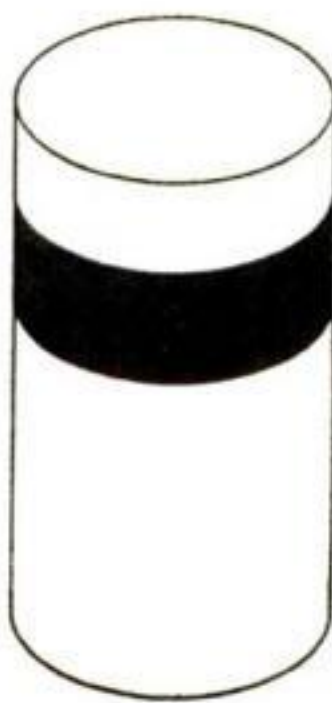


DANGER
OBSTRUCTION
AS INDICATED



New Markers for Waterways

A NEW system of waterway markers has been adopted as standard for the entire United States by the Council of State Governments, a group representing all 50 states. The markers were designed for use in addition to the Coast Guard's established system of navigation aids. Typical markers are shown here.



**MOORING
BUOY**
BLUE
ON WHITE

**SPEED
ZONE**
LIMIT
AS POSTED



▶▶▶ AN INDOOR-OUTDOOR thermometer offers a fine way of keeping tab on the temperature of the water through which you are cruising. Mount the outside unit in a protected spot under water—but not too near the exhaust of an outboard motor, to avoid false readings.

▶▶▶ WADS of rope-type calking compound (such as Mortite) placed under the clamping pads of an outboard motor will keep the pads from shifting or turning.

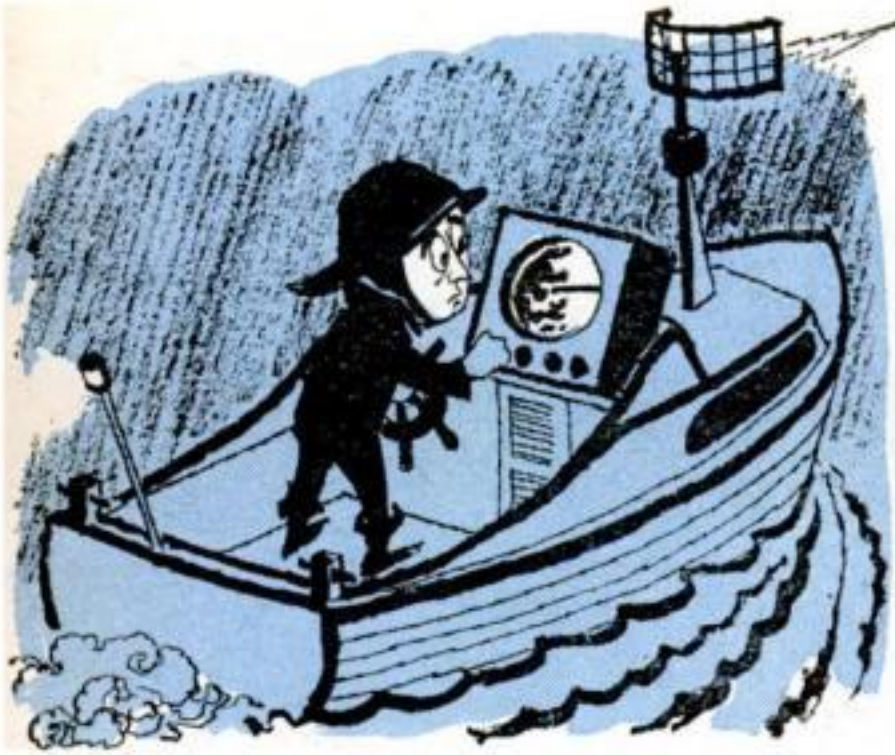


How to Aim a Signal Mirror

WHEN a mirror is used for emergency signaling to a boat or aircraft, aim it by holding your left thumb at arm's length in line with the target. Hold the mirror just above your eye, and find the correct tilt angle to shine the sun on your thumb. When the sun is on your thumb, it will also be on the target.

Electronics Afloat

The modern wonders of radio, radar, and sonar are giving the Saturday skipper a new kind of boating fun



FAMILY boating has gone electronic. Instruments that were once big-ship luxuries now come in low-cost versions—many as home-assembled kits—to make pleasure cruising safer and more fun. Today, electronics will plot your course, fix your position, take depth soundings, let you call your wife at home, spot where the fish are biting, predict the weather, and even take over the wheel for you like an airliner's autopilot.

Radar, though still not cheap, can actually be installed in a small boat for about the price of a color-TV set. In fog or at night, this gives you a map-like image of everything around you on a tiny TV-like screen.

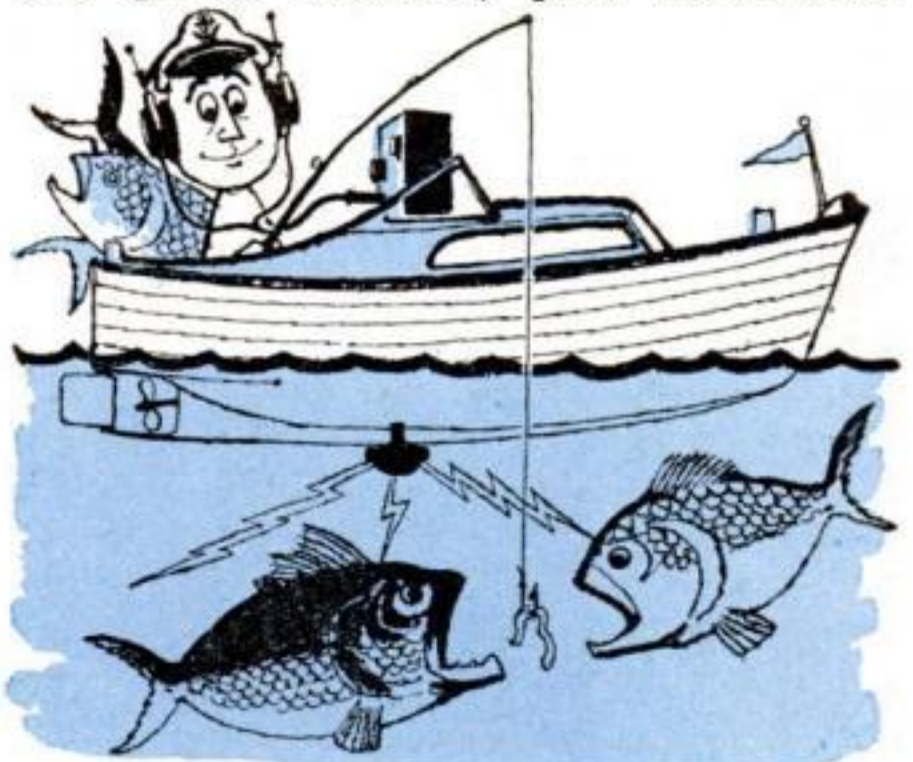
Talking over the water. In addition to standard radio telephones, the newer, much less costly two-way Citizens Band transceivers will keep you in touch with your home or with other boats. They're ideal for small-craft use where a long broadcasting range isn't needed. Transceiver kits, good for sending or receiving up to 10 miles, can be assembled for as little as \$45. (But don't rely on these for distress use—CB frequencies are not monitored by the Coast Guard.)

For shorter-range communication, you can put together a little hand-held "walkie-talkie" for \$25 to \$35. These have a range of one to three miles on water, require no power from the boat,

and can be easily tucked away even in a small outboard. The old-fashioned hand megaphone for hailing nearby boats has gone electronic, too. New battery-powered transistorized models will boom your voice over a mile or more of water in an emergency.

Safer navigation. For use offshore or in storms, there are small, portable radio direction finders selling for as little as \$70. One made by Heath not only lets you fix your position by tracking marine and aircraft beacons, but also receives standard commercial broadcasts so you can listen to your favorite radio programs while afloat.

Other makers have also been quick to see the value of multipurpose equipment that saves on both small-boat space and budgets. Several marine telephones, such as the Pearce-Simpson, double as regular shipboard radios. Another all-purpose receiver, made by Nova-Tech, lets you tune in beacon, weather, marine, and police channels, plus world-wide



short wave and regular AM and FM broadcasts. It sells for less than \$100.

If you want the protection of emergency radio without investing in a full transmitting rig, you can get a little automatic distress signal called the Res-Q-Matic. A slim cylinder about the size of a fire extinguisher, it broadcasts a continuous SOS on built-in batteries and

even keeps working right in the water.

Want to know how deep the water is? An echo-timing device, based on war-born sonar, will tell you to within a few inches as you watch a needle on a dial. Another version will spot a school of fish; the angler never had it so good.

These two devices, while often assumed to be the same, actually work in different ways. The fish finder sends out a continuous sonic beam that changes in tone when it hits a school of fish. By listening to the variations in pitch, you can tell not only the location of the fish but the speed and direction.

The depth finder bounces separate sonic pulses off the bottom and times their return—the longer the lag, the deeper the water. It will also detect fish in some cases, but does not pinpoint their direction as accurately as the fish finder. Prices range from \$70 to several hundred. Another fishing aid records depth and water temperature simultaneously so you can tell whether conditions are right for the fish you're after.

Pampering the power. For your boat's engine, you'll find several new electronic aids. One of the nicest is a universal transistorized tachometer that can be used with any type of engine—inboard or outboard, two-cycle or four-cycle, with any number of cylinders. One low-cost version is sold in kit form by Allied Radio for \$25. It can also be used on a car or other gasoline-powered equipment.

Alternator-type power generators, recently developed for cars, are now being made available for inboard engines by Leece-Neville. Their charm: plenty of juice even at low idling speeds to run all the lights and electric gear that modern pleasure boats carry.

The popularity of twin engines has also sparked an electronic synchronizer



that's said to read engine pulses and provide a precise matching of r.p.m. on both props. Made by Allen-Bradford, it will work on either inboard or outboard engines. Cost: about \$40.

To help you steer a true course, there's even a remote-controlled rudder-position indicator that shows you on a dial the exact angle at which your rudder is turned.

The ancient problem of salt-water corrosion has an electronic cure, too. An accessory sold by Sea Horse Marine "coats" metal hull fittings with a low-voltage current, setting up an electrical "fence" that prevents corrosive electrolysis.

Beating the weather. New transistorized weather-warning instruments indicate wind speed and direction on small dials. Electronic hygrometers calculate humidity automatically. You can even get an electronic thermometer with a memory—it records maximum and minimum temperatures so you can spot weather trends.

For sheer fun, the gadget that may take the prize is Airguide's "Ski-Talkie"—an intercom for talk with your boat pilot as you ski along 75 feet behind him. —Sheldon M. Gallager.

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POPULAR SCIENCE



My **PRIZE** project is...



...a cabin sailboat described in PS

It took me about two months to build this 19-foot cruising sailboat. I call her White Heather. I am sailing her without engines, using the alternative sail plan that your magazine described. In the bilge I have 400 pounds of lead to ballast it. The timbers are of pitch pine, 1" thick, the frames of local mahogany, and the deck $\frac{3}{8}$ " marine ply. A professional made the sails. [Construction of this boat was described in five successive issues of **POPULAR SCIENCE**, March-July, 1941.]

D. B. KILGROUR, Jamaica, B.W.I.



...a cruiser and trailer to haul it

Here's the 20' beauty I built several years ago, riding high on the wooden trailer I built to carry it. The boat has a 7' beam and is powered by a 1955 Caddy engine. We use it mostly for water skiing.

GEORGE HELMS, Los Angeles.

The New Styles in SAFETY WEAR Afloat



**Crew won't don life jackets?
Try these new garments for
careful—yet carefree—boating**

By F. C. Clark Jr.

THE facts about water accidents are startling: Of the more than 6,000 who lose their lives every year, very few actually drown outright. Many, doctors now know, die of shock or heart failure before water ever reaches their lungs. Many more become paralyzed by panic and drown only because they are helpless. Nearly half of those who die are known to be good swimmers. Moreover, many accidents occur close to shore, in protected harbor areas—in some cases right next to the dock.

Why? Two reasons, say safety experts:

1. Trying to swim fully clothed or in rough water is nothing like taking a dip

at the beach—even the strongest swimmer is in for trouble.

2. Many, since childhood, have been so instilled with fear of water that a sudden mishap triggers an uncontrollable panic reaction that leads to shock, clouded thinking, and helplessness. This is nothing to be ashamed of—it happens to most of us.

Add these up and you have a pretty good reason for taking care afloat. Yet few people do. Life jackets, if carried at all, go in the boat, not on the occupants. They're bulky and uncomfortable.

Men are afraid they'll look like sissies wearing them, and women are afraid they won't be looked

at at all. Thrill seekers also insist on perching precariously on decks and seat backs at full speed. To top it off, the modern streamlining of boats has actually increased the chances of an overboard slip by removing handholds and making surfaces as slick and smooth as a cake of ice.

POPULAR SCIENCE

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YEAR SPECIAL

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CONVERTIBLE LIFE PRESERVER looks like sporty sailing jacket at left, even has hood for foul-weather use. In emergency, you pull out tube and blow, as at right. This inflates two bladders to keep you afloat, as shown on preceding page. British-made, the Rockall Inflator sells for about \$30 at marine-supply stores such as Crow's Nest, 16 E. 40th St., NYC.

What you can do about it. Just recently, manufacturers have begun to do something about people who balk at wearing conventional life jackets. Their answer is one of the slickest developments in boating safety: an inflatable life jacket that in normal use looks like an ordinary, attractive sailing jacket. If you take a spill, airtight compartments sewn into the jacket can be inflated instantly to hold you up.

WAIST-TYPE WATER-SKI BELTS, while not true life jackets, are small, easy to carry, can be tossed to someone in distress. Insist your crew wear one, if there's nothing better.

In one type of jacket, the British-made Rockall Inflator, the air chambers are inflated by blowing into a short tube, normally kept hidden in a pocket. It takes only a few puffs to fill the chambers completely. In rough weather, the jacket can be kept partially inflated so that a single puff will complete the job in an emergency.

Another type, also British and soon to be sold in the U. S., requires no inflation at all. Called the Marksway, it uses air chambers with openings made of a special material that expands when wet. Air normally circulating through the jacket is trapped inside as soon as the quick-swelling material hits the water and seals the chambers closed.

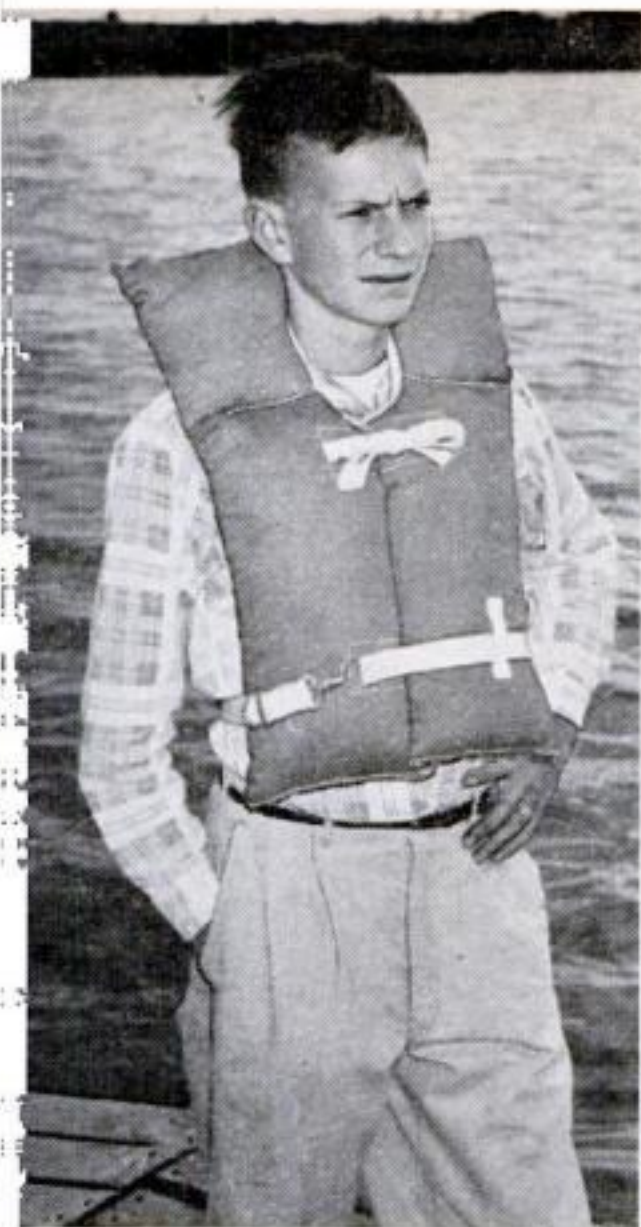
The remarkable advantage of this type is that it automatically goes to work even if you should be knocked overboard unconscious—a not uncommon sailing accident. One minor complaint—if it's a complaint at all—is that the air stays in so well that the jacket must be thoroughly dried out before the sealing material will contract and let it deflate.

Other safety aids. In addition to the jackets, you can also get inflatable life vests that look like the "Mae Wests" worn by airmen. These are inflated by built-in CO₂ cartridges that you trigger by simply squeezing. While they may not be as attractive as the jackets, they're less expensive and can be worn under a regular jacket if you're sissy-sensitive.

Both the jackets and vests have an important double benefit: They not only hold you up, but they give you a feeling of security that chases away panic and shock—the true killers in most cases.

SAFETY HARNESS has line with snap hooks for tethering yourself to boat in rough weather. It can't slip off, has rings for knife or tools. Made by Winslow, it sells for \$16.50.





NEWLY APPROVED LIFE VEST above at left has conventional kapok filling, but is less bulky than older wraparound jackets. It's a good bet for kids since it gives freedom of movement yet does not require inflation in the water. In situations like the one at right, youngsters should be required to wear a jacket at all times. A mishap, even in calm weather and close to shore, can be fatal.

For kids, it's best not to depend on devices that must be operated by the wearer. Conventional life jackets are still the safest bet. The collar type that holds the head out of water is more expensive, but well worth it. The newer vest type is much less cumbersome than the full wraparound jacket and provides a collar. The general design has been approved by the Coast Guard, but be sure the particular make you buy has the approval label—not all do.

If you do a lot of scrambling around wet decks, as on a sailboat, another important aid is a safety harness. This looks something like a parachute harness and lets you tether yourself to the boat so you can't get lost even if you do go over the side. It's especially important if you're out alone or at night. One caution on power boats: Be sure to use a line that's either too short or too long to pull you right into the prop.

Invest also in a pair of special deck shoes. These look like ordinary tennis sneakers, but aren't. Their soles are de-

"MAE WEST" LIFE VEST, similar to airmen's, is inflated by mouth or by squeezing CO₂ cartridges. Made by Winslow Co., Box 1507, Venice, Fla., it supports 350 lb., costs \$19.50.



signed to give a suction grip on slippery decks and actually work better the wetter they get.

None of these aids is intended to be a substitute for legally required life jackets and buoyant cushions. But they are the extra margin that can keep the pleasure in pleasure boating. ■ ■



IT FITS NICELY under the gunwales of a small cruiser (above) while you are under way. Plank here was made of $\frac{3}{4}$ " plywood, weighs only 25 pounds.



Portable Gangplank Beats Wading

By V. Lee Oertle

BOAT trips are a lot more comfortable if you can get in and out of the craft without wading—difficult in shallow-water country. That's when a portable gangplank is useful.

As you near shore, swing wide and let the stern drift in first. Kill the motor and tilt it out of the water. Toss a line to a person on the bank and let him pull you in close. Drop the gangplank brackets on the transom and let the other end down on the sand. Passengers can transfer safely and quickly—without wet feet, squishy baggage, or dampened spirits.

When camping for the night, throw out the anchor with the bow of the boat facing open water. Tie the stern to some handy shore projection or drive in a

short stake ashore to hold the line.

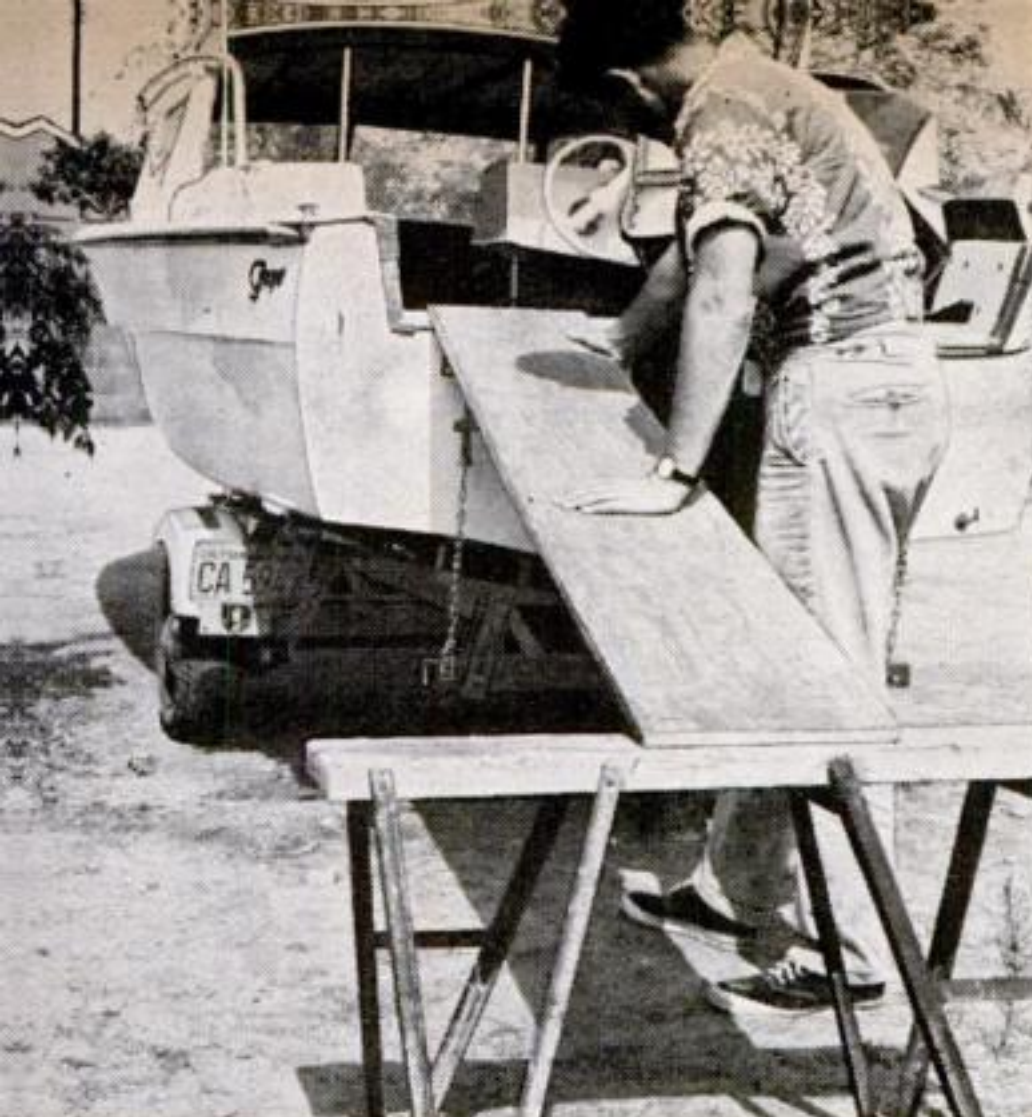
Other advantages to mooring stern-first: Waves from passing boats won't splash over the transom; the boat will be less apt to collect wind-blown spray from an inshore breeze; heavy surf will not pound the hull nearly as hard.

I used $\frac{3}{4}$ " marine-grade plywood 14" wide for my plank. Go over the rough-cut runway with a sander and remove all splinters and rough edges. In making the brackets, remember that a loose fit is desirable, to accept the twist and yaw of the boat at anchor. Make the brackets fairly deep so they will be secure on the transom while the runway is being used.

Scotch Tred for a nonslip surface can be obtained from most marine suppliers. For better appearance and resistance to rot, I applied a coat of yellow paint.

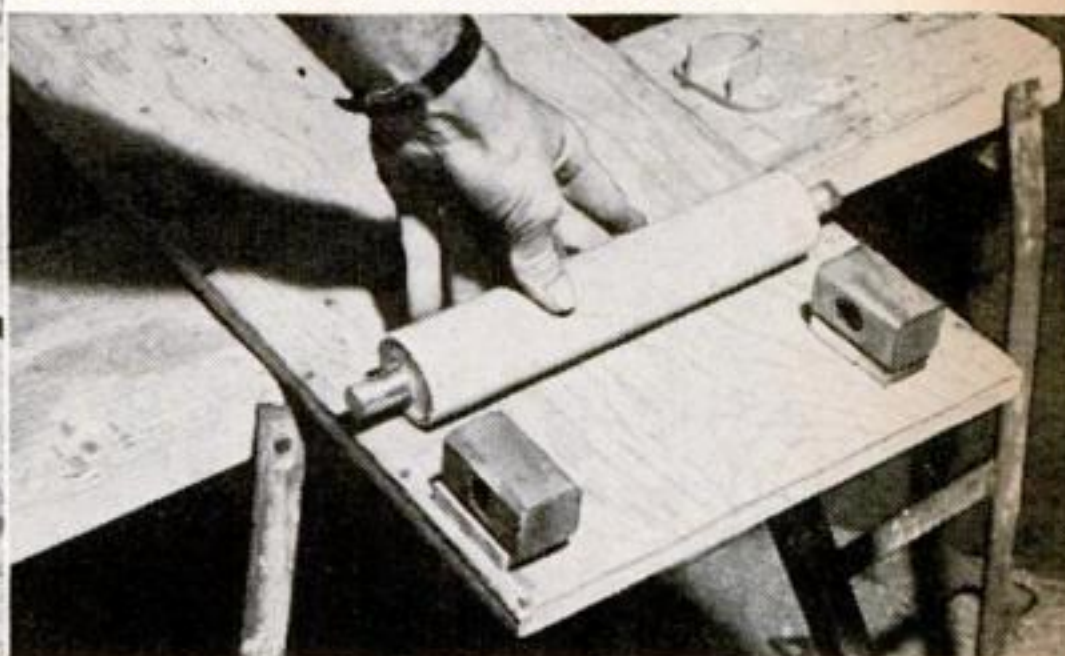
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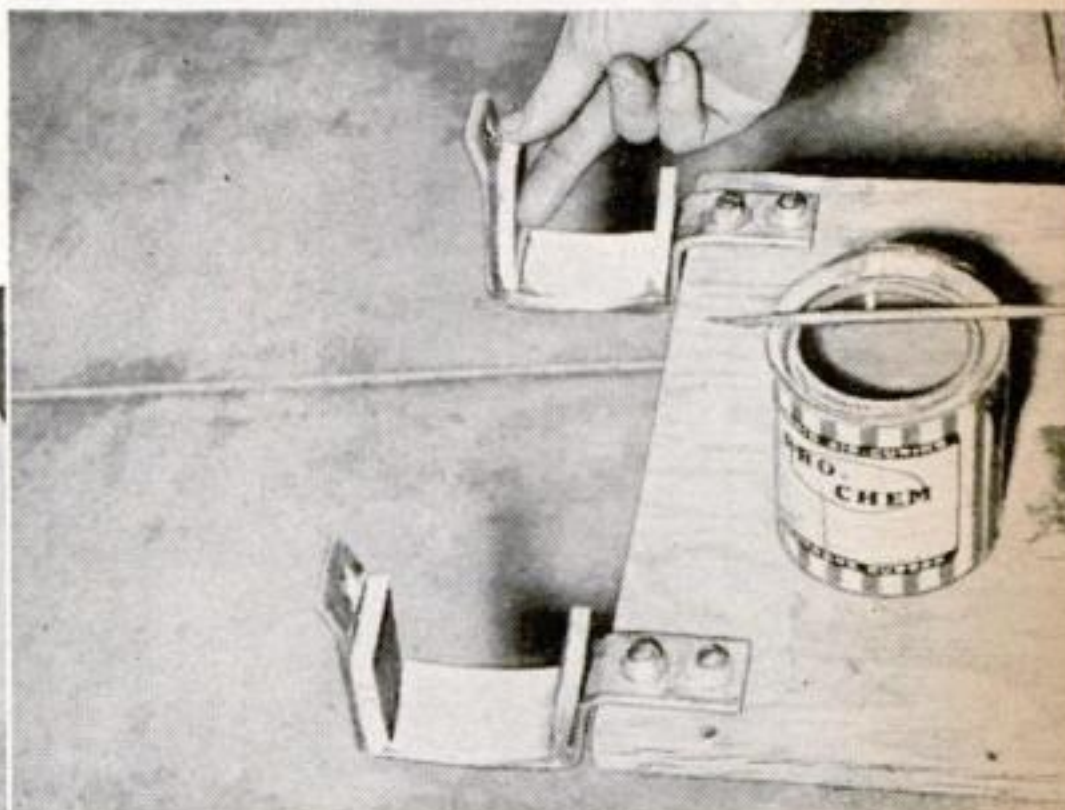


1 FIT THE PLANK in space between transom cut-out and motor shroud. Allow inch or so clearance on each side. Fix length by what you can carry in the boat. This one is 75" long.

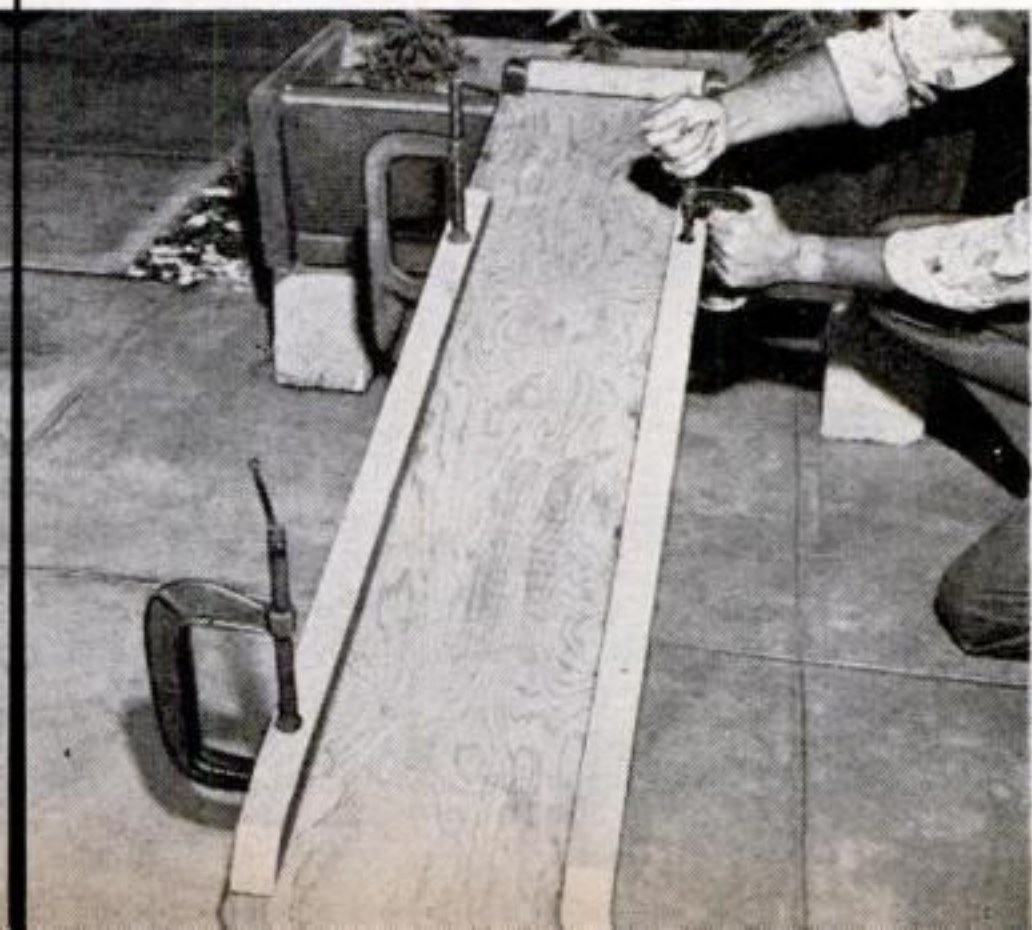
2 MOUNT WASHING-MACHINE ROLLER under one end of plank. Bore $\frac{5}{8}$ " hole in each of two blocks to allow roller shaft to turn.



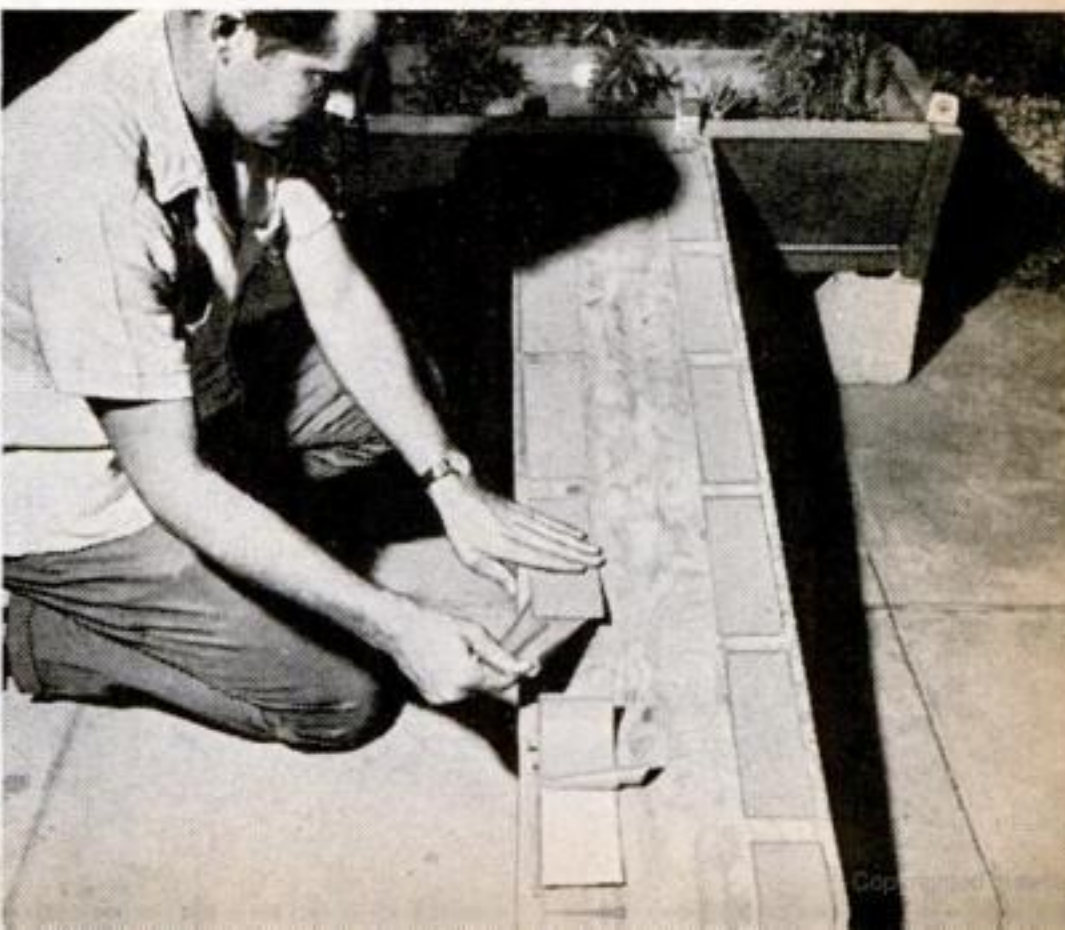
3 STEEL-STRAP U BRACKETS hold other end of plank to the boat transom. These can be formed of two 12" pieces of $2\frac{1}{8}$ " strap, as below. Use rubber cement or liquid neoprene to attach rubber wedges inside the brackets (right) to cushion the metal from the transom.



4 STRENGTHEN THE PLANK with two 48"-long two-by-twos underneath. Clamp them to the edges midway between the ends while you drill each one for four $\frac{1}{4}$ " carriage bolts.



5 A NONSKID SURFACE was provided on the top of the plank by applying strips of Scotch Tred tape as shown here. The material has a surface rough enough for good footing.



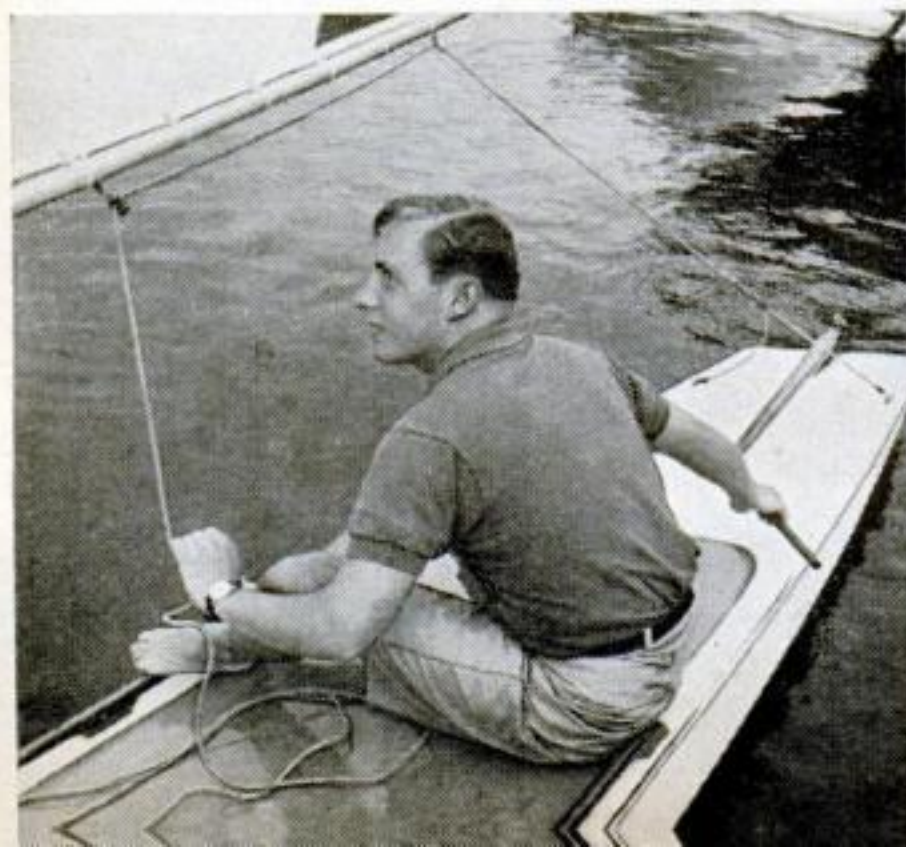
HOW YOU, TOO,
CAN JOIN IN

The Big Boom in SAILBOARDING



YOU CHOOSE FROM TWO DECK STYLES: Most sailboards are flush-decked, like the Sailfish below at left. A patch of nonskid material helps you maintain a firm seat-of-the-pants grip. A

few larger models, like the Sunfish at right, offer a small, kitchen-sink-size cockpit—but not for sitting. The idea is to give you a comfortable off-the-deck place for your feet.





Big sport? As many as 50 sailboards may enter a single race, as at this Connecticut meet.

By George Daniels and Sheldon M. Gallagher

IF YOU wonder how a curious little sailing hot rod could become, in only three years, the world's most popular racing class, just try one. The answer comes fast.

You may end up wide-eyed and wind-blown; for these sailboards, as they're called, are among the fastest sailing vessels ever built. Slither aboard the sleek, surfboard-like hull, haul the sail to the wind, and you're off in a sneaky-quick pickup that's like the difference between a high-powered sports car and the old family sedan.

Your bow starts kicking up a white froth almost instantly, while the swirling foam of your wake disappears behind you at a startling rate. In a minute or two, you're apt to wish you had brakes. In a good breeze, you'll burn up harbor space at 1,000 feet a minute, so there's plenty of opportunity for quick turns and thrilling maneuvers—the kind of fun you get stick-shifting a swift sportster through a tortuous course.

Speeds have been clocked at better than 15 knots officially and 20 knots unofficially—or a flashy 17 to 23 land miles per hour. This is as fast or faster than the fleetest racing sailers now in use, except for a few catamarans and hydrofoil hulls. It also matches the 20-knot speed records set by America's early Clipper ships. In contrast, the average small sailboat you see scudding along at a brisk pace is probably making all of six knots.

What are sailboards? The hulls are

slim, hollow, bullet-nosed, and almost flat on the bottom. Their phenomenal speed is made possible by their narrow beam and low drag.

Most sailboards use a lateen sail that has twin spars instead of a single boom, much like a canoe's sail or those of the ancient Arabian dhow and Mediterranean felucca. The rig is sturdy, easy to handle, and lets you carry a lot of sail on an inexpensive stub mast.

The early sailboards, pioneered by Alcourt, Inc., Waterbury, Conn., came about almost by accident when one of the company's co-owners built a flat little skimmer out of a couple of pieces of discarded plywood just for the fun of it. The fun caught on so fast that Alcourt was soon struggling to keep pace with orders for what was to become the now-famous Sailfish. In the past three years, 20,000 have been sold. Last year, sales zoomed to the \$1,000,000 mark. Overnight, a whole new class of racing sailers has blossomed into the world's biggest for one-design boats. It took the Snipe-class sloop 40 years to reach 13,000, and few other classes have ever hit half that figure.

The first Sailfish was 11' 7½" long, mainly because marine plywood came in 12' lengths. Since then, Alcourt has added a larger Sailfish with a 13' 10" length, plus a new model, called the Sunfish, that has the same 13' 10" length but a fatter beam for greater stability and capacity.

Construction has also been slicked up



RIDING PIGGY-BACK, lightweight sailboard is quickly lifted off a car-top carrier. From there, it's an easy two-man job to walk the hull, fully



rigged, right into the water. For one-man handling, a wheeled dolly can be slipped into the daggerboard slot, as seen at the left.

to include plastic-covered plywood for the less-expensive models and mirror-smooth molded fiber-glass for the deluxe versions. The larger Sunfish sports a tiny cockpit that looks like a sink, even to the "drain plug" in the bottom. This is a self-bailer that uses suction to draw water out of the cockpit at speeds above six knots. The sailboard is one of the few types that can use a self-bailer: It operates at speeds that most sailboats never reach.

Prices start at about \$300 for a plywood Sailfish and go on up to \$450 for a fiber-glass Sunfish. The plywood type also comes as a kit, complete with sail and paint, for about \$298.

Sails, in eye-popping stripes or solid

colors, are available in cotton, or in nylon for about \$20 more. In addition to Alcourt's fish, there are a number of other sailboards, some selling for less than \$200. Royalty Sports' Minnow goes for \$163 and O'Day's Kitten for \$199.50.

Why the boom? Speed is only one reason for the sailboards' success. They're so light—139 pounds in fiber-glass—that you can store one on a garage wall like a garden rake. Transporting it to water is merely a matter of flipping it onto a standard car-top carrier. You don't need a trailer.

At the water's edge, you slip the mast into a hole like a candle into a candlestick, fasten a few ropes, and you're ready to go in two minutes. The keel is

Flip a fish and she's back on her keel in one minute



HOPELESSLY HULL UP, this fish looks as if it's out of the race. But don't bet on it. In first photo,



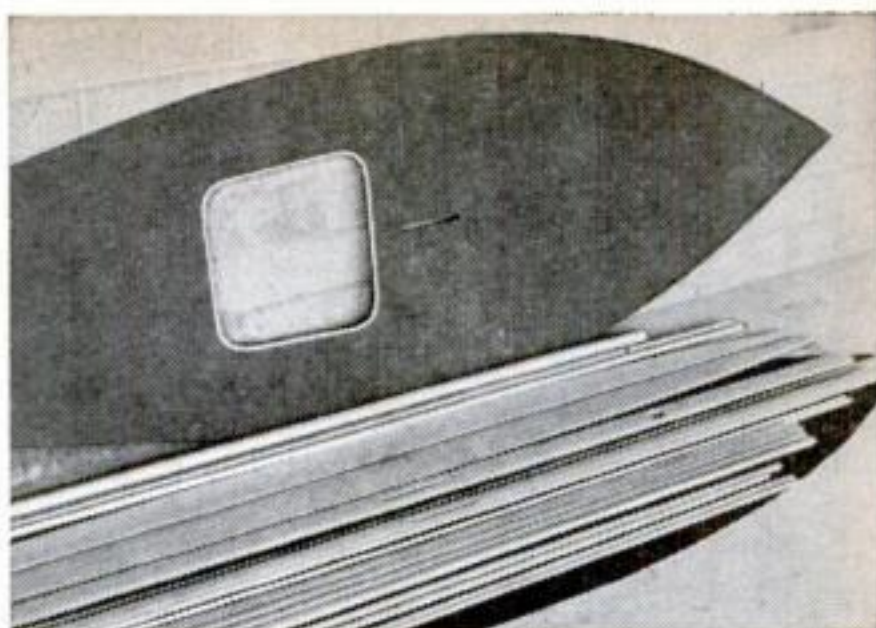
skipper levers feet against bottom while hauling on daggerboard. As she starts to rise, he

in the form of a removable daggerboard that you simply push down or pull up through a slot in the hull. The rudder is pivoted so you can tilt it up during launching or beaching to keep it from hitting the bottom. What's more, the sailboard is one of the few boats that can capsize in the middle of a race and still go on to win. The reason: The light hull can be rolled back on its keel in about a minute flat, as shown in the pictures below.

The only thing you have to remember is that a sailboard is definitely a bathing-suit boat. If you're going to heel one hard, you must expect an occasional dunking. Still, flipping in a sailboard is not the catastrophe it can be in a larger boat. You merely scramble back on and sail off. The plywood hulls are naturally unsinkable, and the fiber-glass jobs have built-in flotation. But the biggest single reason for the boom in sailboards is this: They give you, quite literally, the thrills of big-time sailing at a small-time price.

What it's like to sail one. There are only two controls, the tiller for steering and the mainsheet rope for setting the sail angle. The mainsheet is your throttle—pull on it and you speed up, let it out and you slow down.

To get going, you "fall off the wind"—turn slightly away from the wind to catch the full force more directly. Those

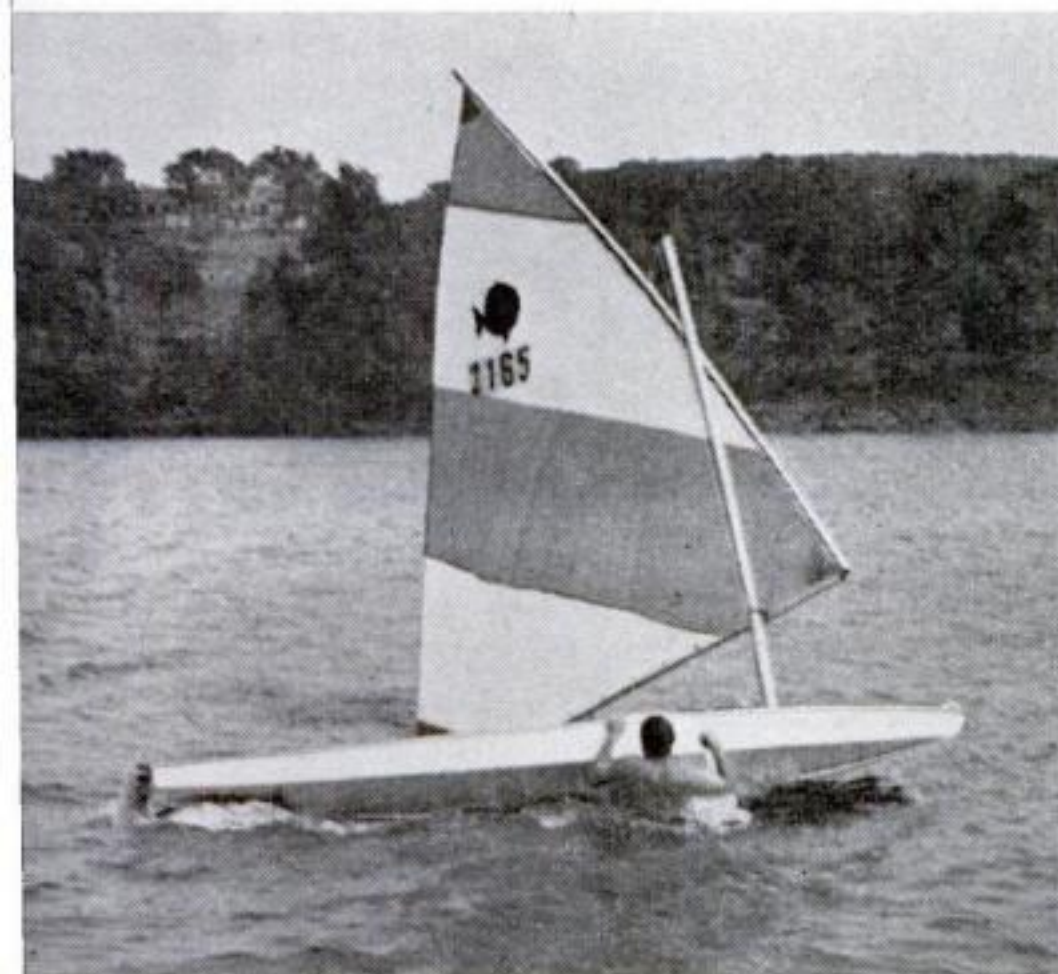


SAILBOARD KITS include precut deck, ribs, bulkheads, mast, even hardware. They go together in a few weekends, save you about \$100.

familiar only with motorboats will be amazed by the weirdly silent, sudden surge of power. As the pace quickens, you haul in the sail, the hull starts to heel, and you slide up to the high side for balance. In seconds, you're at full throttle.

You eye the bubbles trailing off at the stern. If they show a decrease in speed, you know you're sailing too close to the wind, and you fall off to pick up again. You can sail at any angle up to 45 degrees to the wind—something only the best sailboats can do. If you heel over too hard, you ease off on the sail to slip wind and slow down. This is your brake.

When you turn by heading into the wind, you're coming about. This is the



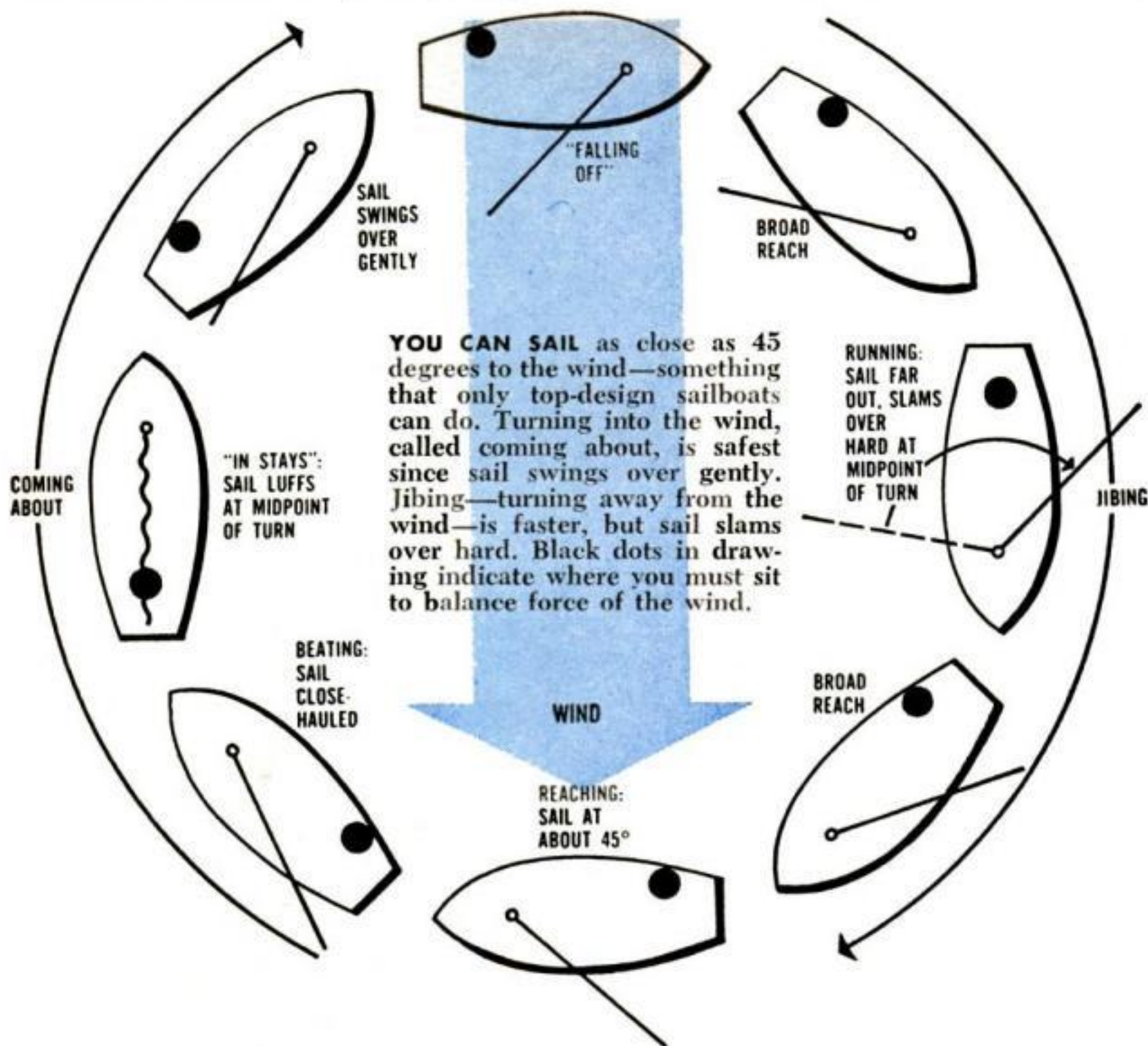
puts full weight on daggerboard and yanks on gunwale to roll her back up. Finally, wet but



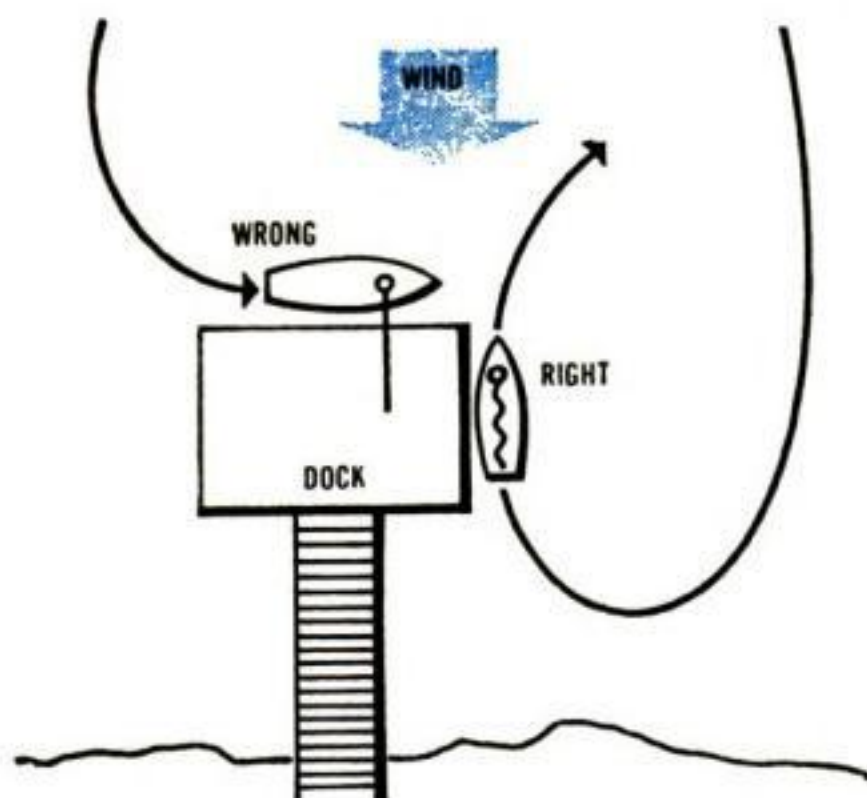
undaunted, skipper slithers aboard and sails off—in one minute by stopwatch.

CONTINUED

Sailboards can do anything big sailboats can do—sometimes better



How to dock a sailboard



SAILBOARDS ARE SO FAST you can easily shoot right past a dock—or into it—if you approach with the wind. Proper landing technique is to pass the dock and loop back upwind. This kills off speed quickly and lets you drift smartly up to the side of the dock, bow out.

safest way since the sail swings gently to the opposite side as you come around. To avoid losing headway, some skippers fall off a bit ahead of the turn to pick up speed, then put the tiller over hard to complete the turn fast.

You can turn faster away from the wind—called jibing—but this is tricky. The sail slams over hard, like an umbrella caught in a gust. You have to duck fast and shift your weight or you may go over.

About this time will come the suspicion that sailboarding can never be dull. The switch from an ordinary sailboat is like swapping a bus for a jet. Seaman-ship comes fast on a sailboard—it has to. In minutes, you're executing showy, female-impressing maneuvers that make ordinary sailboats look as if they're wading in molasses.

What to look for. When you buy a sailboard, remember that its chief charm,

[Continued on page 230]

For Economy, Build the Ugly Ducker

You needn't be a hunter to enjoy this easy-to-make tub. Kids will love it for calm-water paddling

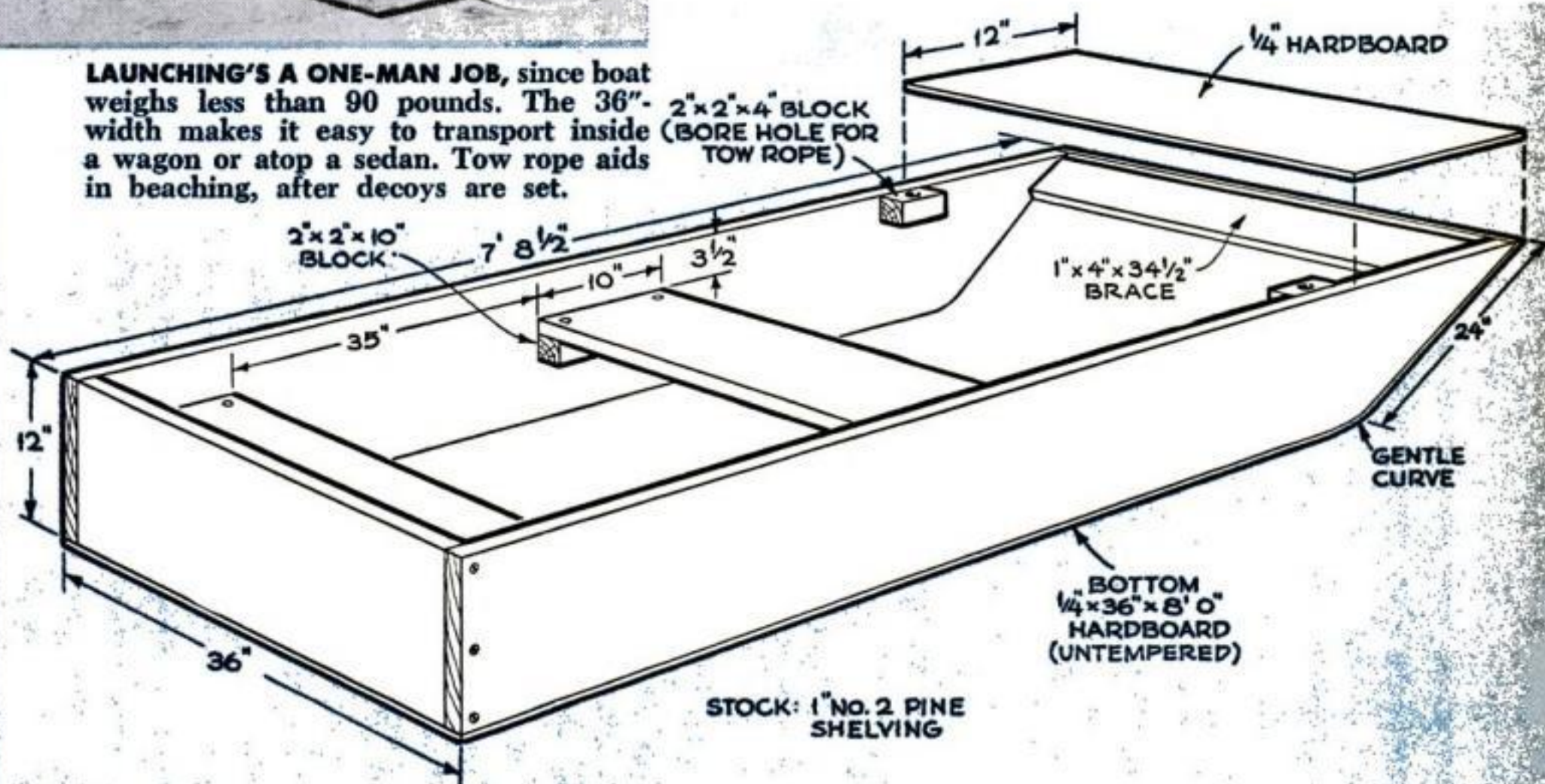


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SO IT looks like a mortar-mixing box—who cares, as long as it serves the purpose? And that purpose can be: hunting the sloughs, calm-water fishing, or lazy rowing or paddling on reservoirs or placid rivers. You could even add a one-horse kicker.

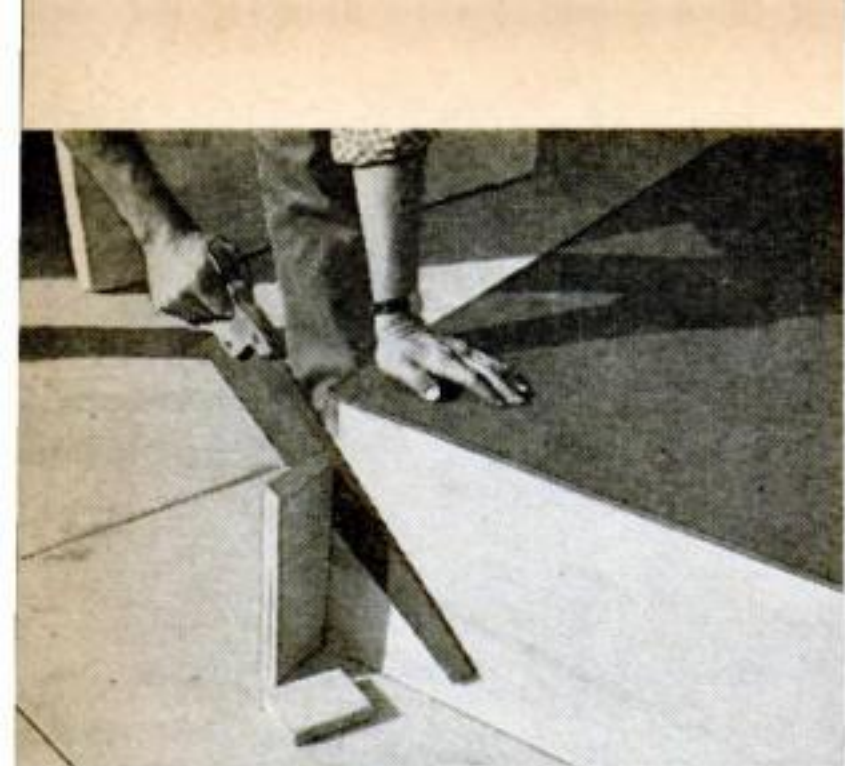
The economy—I built mine for under \$18—lies in using low-grade stock, but finishing off with high-strength fiber-glass saturated with

LAUNCHING'S A ONE-MAN JOB, since boat weighs less than 90 pounds. The 36"-width makes it easy to transport inside a wagon or atop a sedan. Tow rope aids in beaching, after decoys are set.

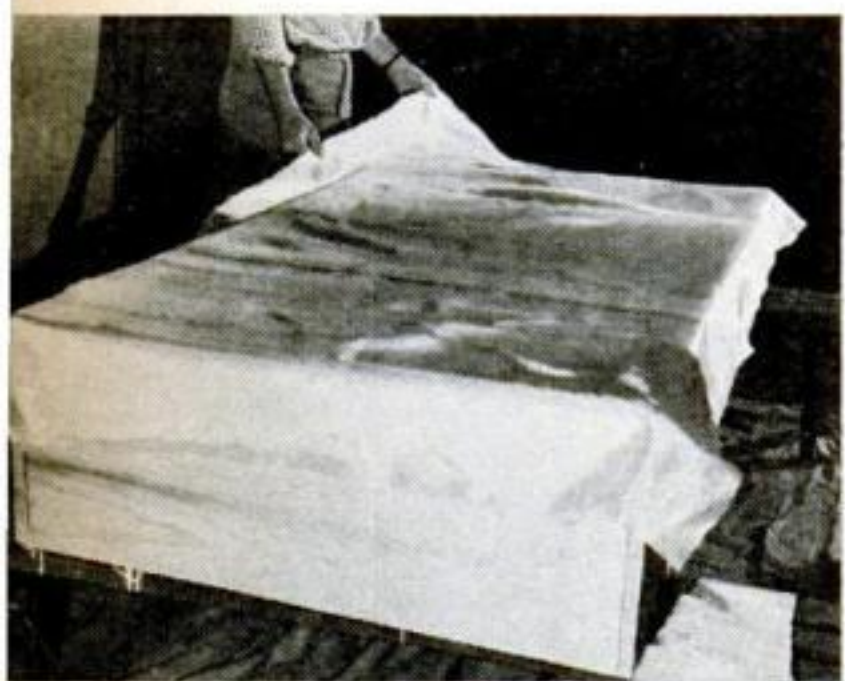


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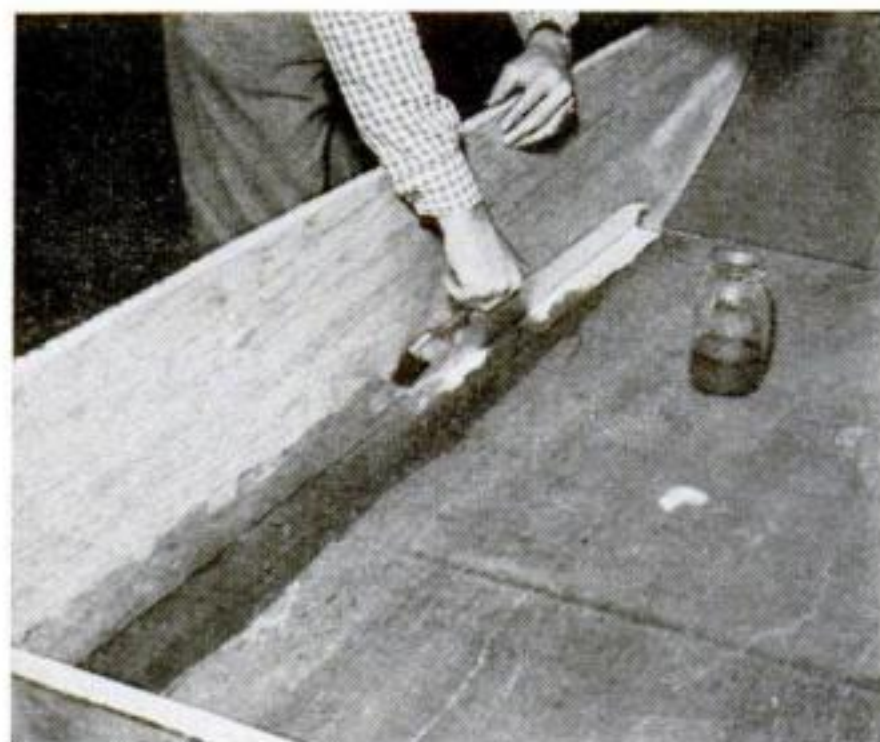
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TRIMMING SIDE BOARDS after bottom panel is attached and transom is set flush with its rear edge spares you tricky mating of bent hardboard and precut sides.



FIBER-GLASS SEALS HULL against leaks. Lay out overlapping strips to cover bottom, leaving about 4" to fold over sides and transom; run cloth halfway up bow bevel.



SINKPROOFING IS OPTIONAL. Trim a 72"-long panel of 2" Styrofoam to 34½" width and lay it flat on bottom before installing seats (photo left). Cut thin plywood same size to lay on top; secure it to sides and transom with 4" strips of fiber-glass, coated with boat resin.

boat resin. Lumber can be No. 2 pine shelving, if you're willing to brave cold stares at the lumberyard while you cull out two eight-foot lengths of sound one-by-twelves (as few knots as possible). Before they throw you out, grab an extra piece for the transom, plus a couple of one-by-tens for seats.

Clamp the side boards together so you can cut and sand both contours at once. Unless you enjoy bailing, be sure these edges are smooth, so that the bottom panel will butt tight. Separate the side boards and stand them upside down on a level floor. Tack on temporary braces to space them 34½" apart. Rip one foot off the width of a hardboard panel and begin fastening it at the bow end, spacing the nails 2" apart. Draft an indulgent friend to hold the free end of the panel up, lowering it gradually (as you nail alternate sides) to establish the curve. Untempered hardboard bends best.

Fasten the bow brace by nailing through the hardboard and clinching inside. Slice a 36" length off that left-over strip of hardboard and nail it to the gunwales. If you're brave and eager enough to skip the optional sinkproof feature, go ahead and install the seat planks.

Waterproofing the hull. After you've covered the bottom with fiber-glass, as shown, squeegee catalyzed resin over it for thorough saturation, working out all air bubbles. You'll need about 1½ quarts. When the resin has cured (about 24 hours), smooth the rough edges along the sides with a power sander.

Still wary about putting to sea in a sandbox? You can make the boat virtually unsinkable by sandwiching a panel of foam between the hardboard and an auxiliary floor. It adds about \$7.50 to the cost, but will keep you afloat even if you blast a hole right through the bottom.—V. Lee Oertle.



Wood Bargains from Country Sawmills

By George Daniels

ALMOST anywhere in the U. S., you're within easy driving distance of a source of remarkable lumber bargains—the small country sawmill that cuts native lumber. Hundreds of them dot wooded areas from coast to coast. Look for their signs, ask when you gas up, check the yellow pages.

Typical board-foot sawmill prices in my area (New England) are: clear pine 10 cents, clear oak 17, walnut 25—most in widths up to 12". For a cent or two more you get widths of 18" in oak, 24" in pine—ample to make table tops or solid doors in one piece or with a single seam. Some sample lumberyard prices in the same area: clear

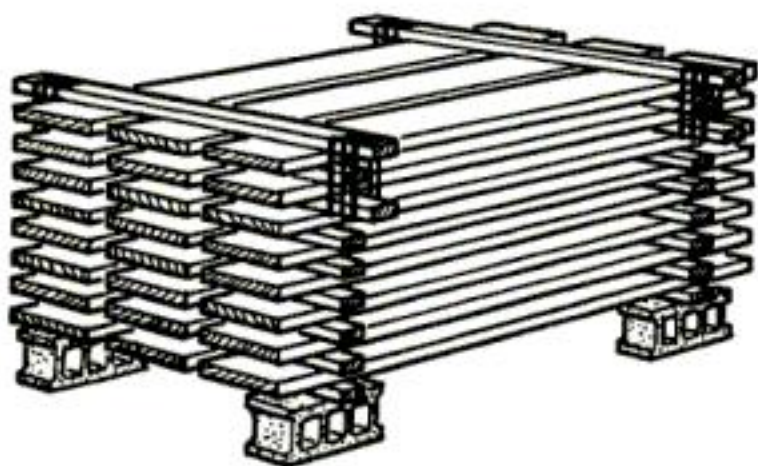
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How to Stack Green Lumber for Air-Drying

Raise the first course well off the ground on blocks. Use cross sticks at least 2" thick for good air circulation. Place them directly above each other so that the weight above won't bend the lower boards. Leave space between the board edges, and keep the stack narrow rather than wide for best air flow.

Because the top boards dry faster on the upper surface, they tend to cup



upward and distort. To prevent this, weight them down or lash together the top sticks as shown. Another method: Flip the top boards over frequently. The cross sticks should be moved slightly at intervals to expose the area they touch and permit that to dry, too.

If possible, do the stacking in a shed. Otherwise, cover the top with tar paper or roll roofing, with scrap-wood spacers between the covering and the top board surface.

How to Check Wood Seasoning

Cut a small sample from the stack and "kiln-dry" it at 212 degrees in your kitchen oven until it shows no further weight loss in a few successive weighings on a postal scale.

To this weight figure add 12 to 15 percent. (This compensates for the average exterior moisture content.) Use this figure as a gauge.

When another sample of the same size cut from the stack weighs about the same—your wood is seasoned.

pine 45 cents, clear oak 48, walnut \$1.

Some prize buys may come from the scrap pile, waiting to be cut into firewood at about \$12 a cord. Here you'll find slabs sawed from logs to square them before they're ripped into boards. Squaring a bowed section of log often results in an oval-shaped slab—in hardwood usually rimmed with pale sapwood and centered with dark heartwood.

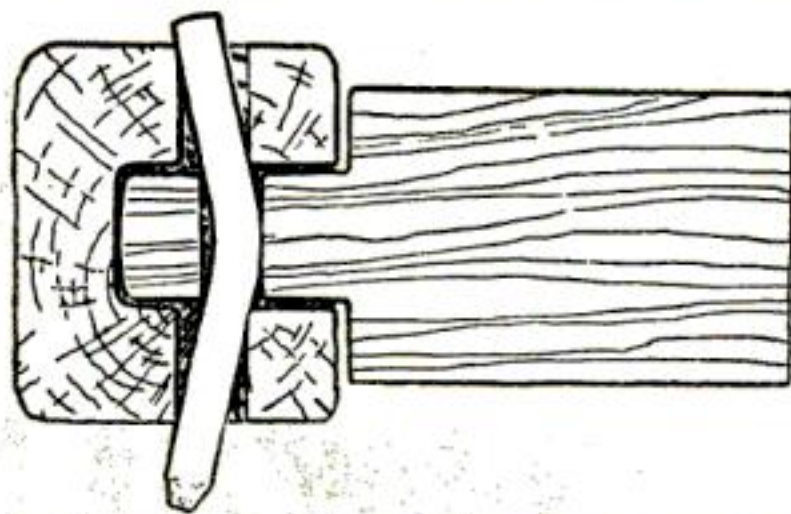
For paneling in your den or game room the small mill can rip a stack of boards from a single log with a grain and knot pattern that can be matched across an entire wall. Yet the natural variation in each piece distinguishes it as real wood, not a veneer or synthetic, and you get it at the regular board-foot price.

For special siding on a country cottage or vacation cabin, the mill provides

Ways to Make

UNSEASONED-WOOD techniques used in some of the country's oldest structures will still work well today when used with fresh-cut mill lumber. Here are several of the basic ones you should know:

Pegged mortise-and-tenon joints of barn and shed frames are locked by a green peg driven through holes bored slightly out of alignment in both parts.



The peg must flex to pass through, as diagramed. As it dries, it hardens with a permanent zigzag; it can't fall out or be pulled out. It doesn't shrink loose in the holes, as the green timbers (and the holes) shrink with it.

Vertical softwood siding is nailed up green by setting boards snugly edge to edge and nailing a third of the way in

"wavy-edged" planking that retains the natural surface contours of the log along both edges. It's sold at board-foot rates, usually based on the midsection width of each board with an ample allowance in your favor for error.

Log-cabin materials are a small-mill specialty. Order your logs with a slab from opposite sides so the flat lower surface of each log rests on the flat upper surface of the one below. You pay according to the board feet of the logs. Typical price of 6" pine with two flat sides is 30 cents a running foot. That's just 60 cents a square foot for your walls, and you don't need framing. To cut costs, have them ripped down the center and use them over framing; with the bark side out, you cover twice the area for almost the same price.

Grading of lumber. At the small mill, grading is not a systematic matter. Some sell bulk orders on a run-of-the-mill basis. You select the species but take random grades as they come from the saw, some clear, some knotty. If you want only a board or two you can usually pick them out.

Other mills grade by the log. But log lumber, from ground level to lower tree branches, is priced highest by a few cents because it is clear. Knots resulting from branches reduce the price from higher trunk sections.

Seasoned or green? The small saw-mill usually sells both ways, and is your only source of cut-to-size "wet-green" hardwood. This is a must for steam-bending jobs like boat frames and furniture parts. Far more flexible than sea-

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Use of Green Wood

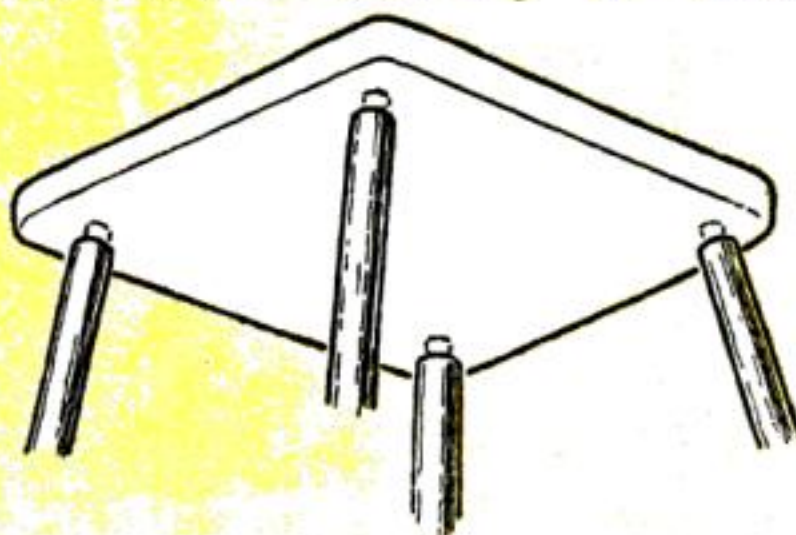
from each edge, with nail points slanted toward each other. Shrinkage (less than $\frac{1}{8}$ " between nails in a 12" board) is absorbed by wood slippage on the slanted nails, which also draws the boards inward against the surface to which they are fastened.

Battens (old method) are nailed over the seams, but to one board only, until the siding seasons. Then they're nailed to the adjacent board, with nails spaced between the original ones to provide "give" with seasonal swelling and shrinking. Newer method: Drive the batten nails through the seam between boards into nailing strips behind them. Both systems work nicely.

Horizontal siding is nailed up green with nails along top edges of boards only,

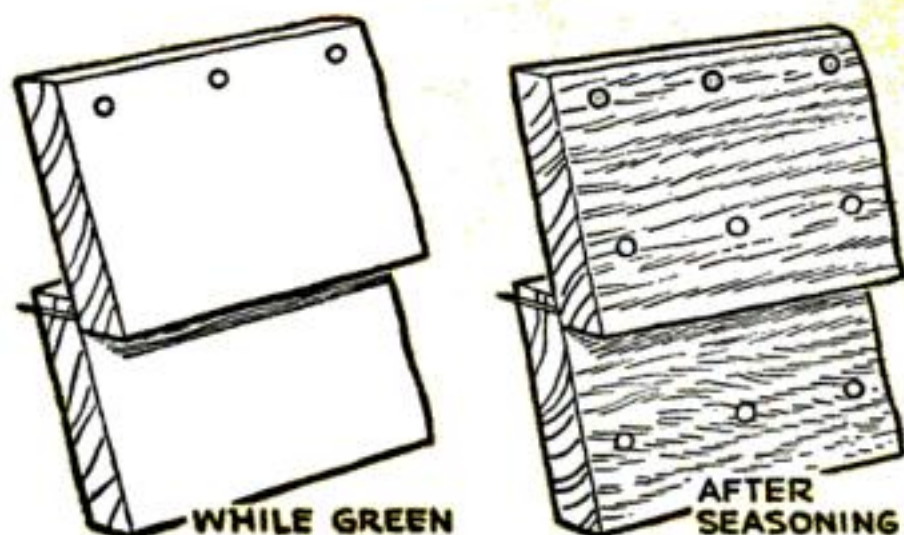
until seasoned, then a third of the way up from bottom edges.

Boards shrink in thickness as well as width, so any green-mounted siding calls for once over lightly with a hammer after seasoning to drive nailheads down flush where wood has shrunk away from them. A point to keep in mind: Green siding boards will cup outward slightly during the start of seasoning (as moisture



leaves exposed outer surface fastest), then flatten.

Old-time furniture makers used green wood in combination with seasoned wood as a substitute for glue. Use a green slab for a chair or bench seat and drive seasoned legs snugly into holes bored in it. When the slab shrinks with seasoning, the legs will be held in place for keeps.





ROUGH WALNUT SLAB above was bought at sawmill for only 75 cents. Carton shown with it contains ready-made legs. At right above, a close-up of saw marks on board.

soned stock, it can be steamed around a much tighter radius without cracking. Tip: If wood is wet-green, a wet spot appears around a nail driven into it.

Air-dried lumber is backlogged for a constant supply by some mills and priced a cent or two higher than green stock. Others stack their surplus for drying with no price change. When only green lumber is available, you can use it for many purposes by following time-proven techniques. Or you can air-dry it yourself.

Here's the sawyer's rule of thumb for seasoning time of 1"-thick boards:

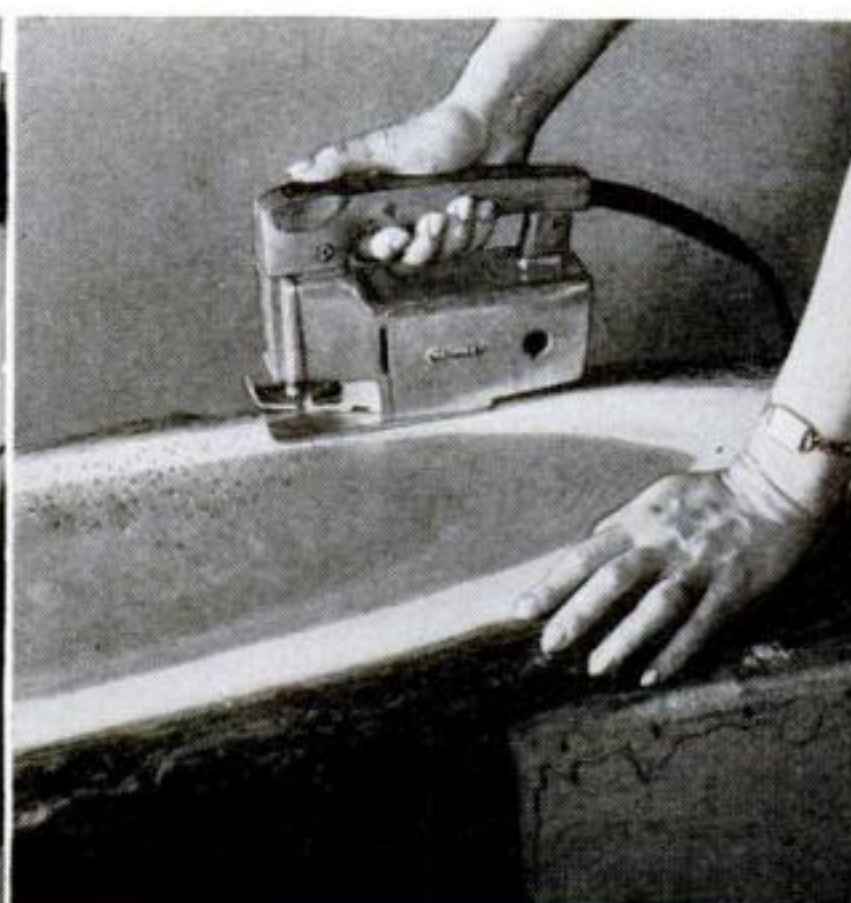
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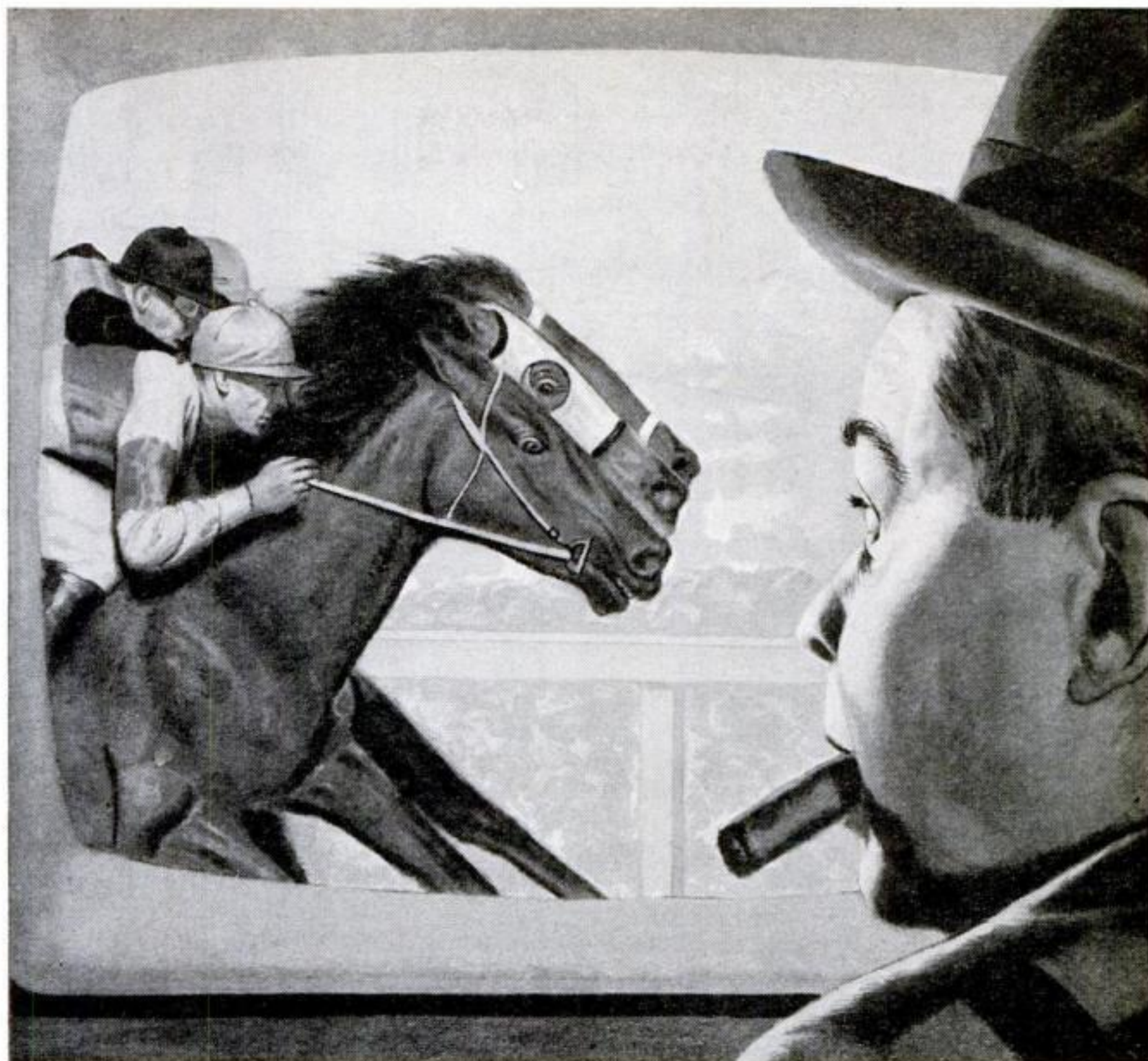
Making a coffee table from a rough slab



RENTED FLOOR SANDER (below) dressed off all saw marks on one side in about 40 seconds while wood was still green. Final sanding was done with disk sander before slab was edge-trimmed, to keep edges square.

EDGE WAS TRIMMED from the 1¼"-thick table top just inside the bark line in the natural outline of the slab. As you see in the photo above, the finished surface has a complete sapwood rim around a darker heartwood oval. No glue was needed to hold the legs. Drying, the green wood of a slab like this shrinks snugly around the seasoned, ready-made legs.





Fixing TV's Dead Heats

by Art Margolis

THE first thing you do when your TV conks out is look for a tube that's not lit. If you spot one, more times than not you've found the trouble. If you can do that much, you can go further and handle the rest of the TV heat ailments. You'll see what I mean in three case histories of sick sets I ran into.

In Case of No Light

THE first case illustrates a point that even some TV repairmen ignore. It was brought in by Al Worth, whose fas-

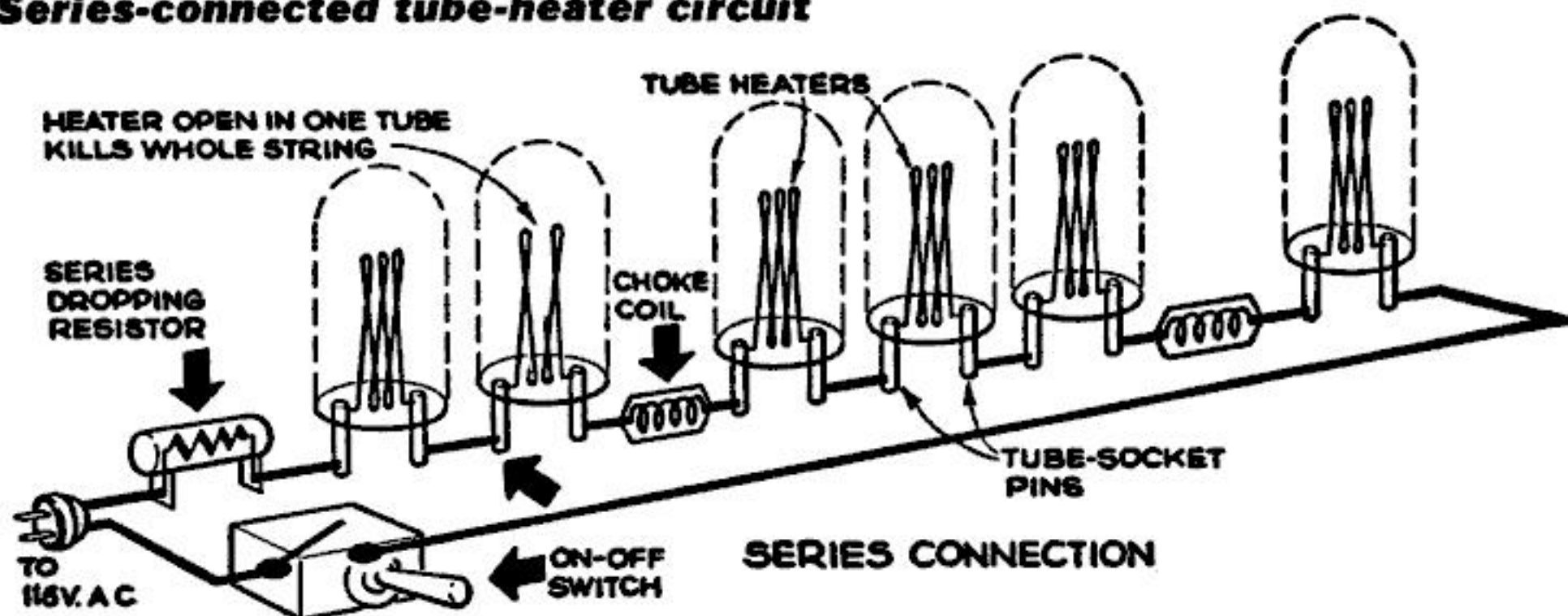
cination with the art of improving the breed of horses colors his whole outlook on life. He hefted his portable onto our sets-fixed-while-you-watch counter.

"She's pulled up lame," he announced.

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Series-connected tube-heater circuit



"Third time this meet. Can you doctor her up or do I put her out to pasture?"

I turned on the TV. Nothing happened. I removed the back and poked my neon tester into the line cord. The bulb lit. Juice was reaching the chassis, so the line cord was not the trouble maker. I installed my own cheater cord. The tubes still remained out cold.

Heaters are powered in one of two ways—parallel or series. For parallel circuits, the 115-volt supply is stepped down to about six volts by a filament winding in the power transformer. Series-fed heaters are wired together like Christmas-tree lights and hooked across the 115-volt line. If one element in the series string opens, all heaters go dead. In a parallel-fed circuit, only the defective tube will fail to light.

Timed-Warmup Tube Types

Use of these tubes in series-string TVs gives longer tube life. Warmup is timed to occur in 11 seconds.

2BN4	3DT6	5CL8	6CU8	12AX4GTA
2CY5	4AU6	5CQ8	6EA8	12B4A
2EV5	4BC8	5J6	6J6A	12BH7A
3AL5	4BE6	5T8	6S4A	12BK5
3AU6	4BN8	5U8	6SN7GTB	12BQ6GTB
3AV6	4BQ7	5V6	6T8A	12BY7A
3BA6	4BS8	5X8	6U8A	12CA5
3BC5	4BX8	6AW8A	6V6GTA	12CU5
3BE6	4CB6	6BA8A	7AU7	12CU6
3BN4A	5AM8	6BH8A	8AU8	12D4
3BN6	5AN8	6BK7B	8AW8A	12DQ6A
3BU8	5AQ5	6BN8	8CG7	12L6
3BY6	5AS8	6BY8	8CM7	12W6
3BZ6	5AT8	6CB6A	8CS7	13DE7
3CB6	5AV8	6CE5	9AU7	17AV5
3CE5	5BK7	6CG7	9BR7	17AX4
3CF6	5BQ7	6CG8A	9CL8	17D4
3CS8	5BR8	6CL8A	9U8	17DQ6A
3CY5	5BS8	6CM7	10DE7	19AU4GTA
3EV5	5CG8	6CS7	12AV5GA	25C06
				25BM6

I checked to see if the set had a series or a parallel hookup. There was no power transformer so it had to be series.

There are five kinds of parts involved in a series string: on-off switch, resistor, choke coils, tube sockets, and tubes. By far the most common cause of a dead series-wired set is a burned-out heater in one of the tubes.

I started testing the tubes. Little Al pointed to one. "I'll give you even money it's the one in the corner."

He was pointing to the damper, a 12AX4-GT. Al continued, "I've run this six years. That's the favorite."

As soon as I saw the tube, I knew it was a good bet. There was a reason. I reached for a 12AX4-GTA to replace it.

"Uh-uh. That's the wrong tube. You've got a GTA, not a GT," Al said.

"That's right," I said. "But it's better."

"Look, pal," he said, "don't you try to tout me onto that, too. A shop in Hialeah tried it last winter, but I wouldn't let 'em."

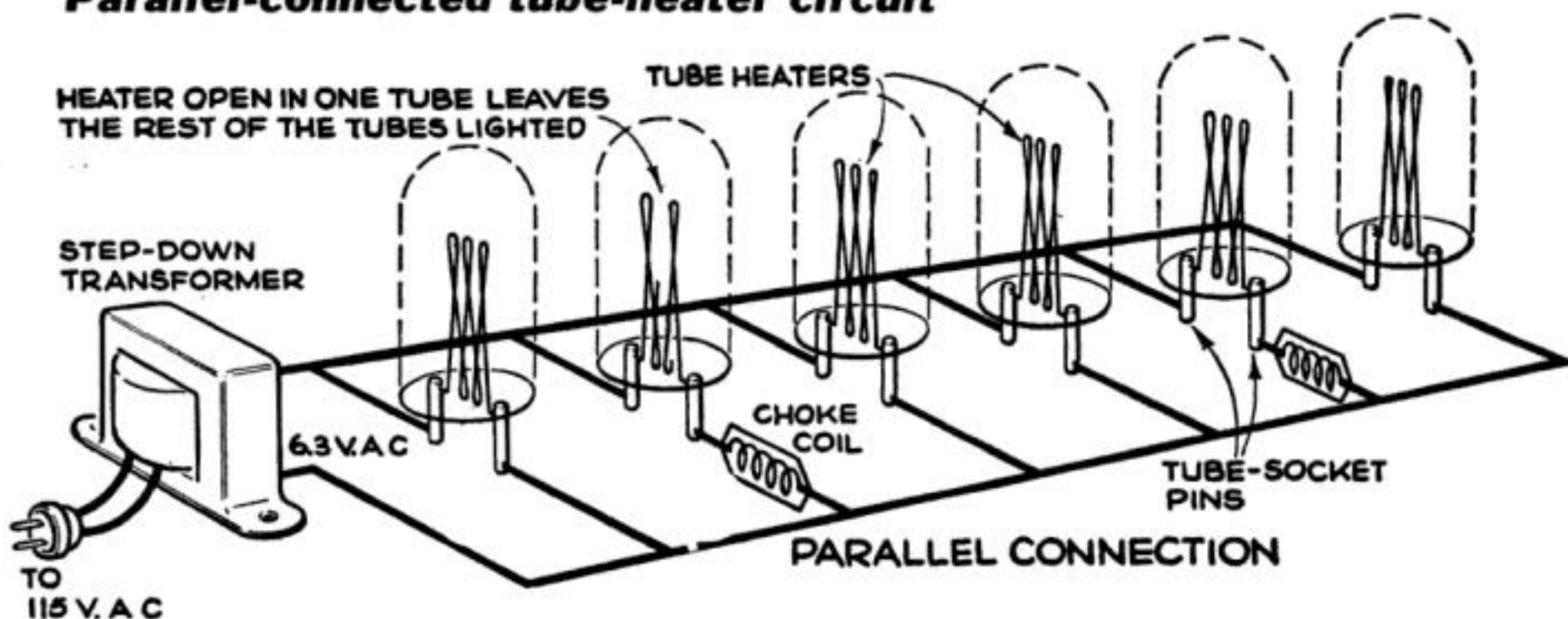
I held onto my temper. "Listen, Al, you say the 12AX4-GT has been burning out more often than the others. Maybe there's a reason."

"Maybe," he admitted.

"Okay, here's why: When you turn on the set, a race begins. Electricity spurts into all the tube heaters. The heaters begin to heat. Some are slow heaters, some fast. But the pace setter takes a lot more punishment than the rest of the field. Your 12AX4-GT is the favorite. It wins every time. But it can't stand the pace for very many meets. It's the first to burn out."

"Maybe we can fix the race, huh?"

Parallel-connected tube-heater circuit



There was a larcenous glint in Al's eye.

"That's the idea behind the GTA tubes. They're made with a 'fixed' warm-up time—exactly 11 seconds. They run a dead heat; the current surge when you turn the set on is borne equally by all heaters, so they last longer."

As I put in the 12AX4-GTA, Al asked, "How many tubes in there?"

"Sixteen," I replied.

The set worked fine. Al paid the bill and started out the door lugging the TV. Suddenly he looked back. "Wow!" he said in awe. "A field of sixteen in a dead heat!"

The Mystery of the Tube Flameout

MY YOUNG cousin Pete, who has become a pretty good TV repairman, came to me with the air of a little boy bringing home a bad report card. "Art," he said, "I can't repair my own TV."

"Maybe you're like a doctor who can't cure his own child," I said. "Let's have a look."

It was a transformerless chassis (series-string heaters). All the tubes remained cold when I turned it on. I started checking and the fifth one I took out—a 12AU7—had open heaters.

"What's so hard about that?" I said as I inserted a new one. The tubes lit and the picture and sound came on.

"Yeah, I know," he snorted. "Wait."

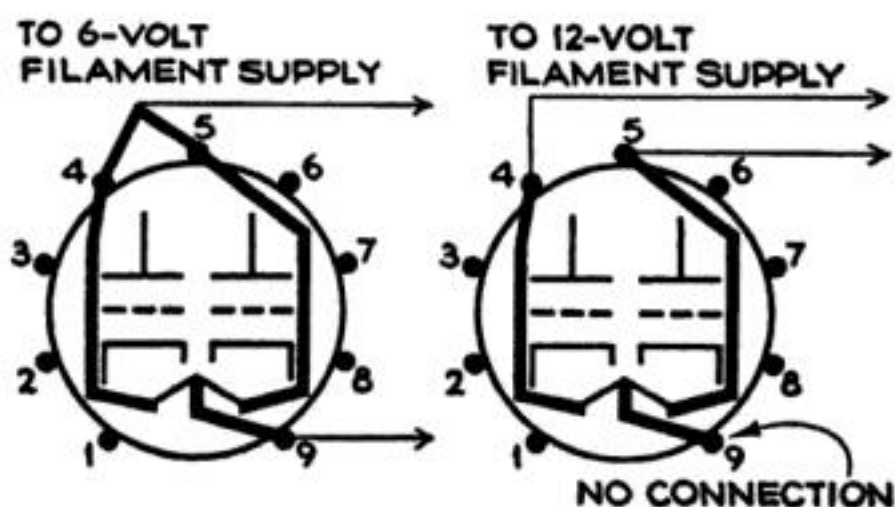
In about five minutes the new tube flared up brightly and popped out.

Pete pulled two other 12AU7s from his pocket and groaned, "These two got it the same way."

I started checking around the socket with my ohmmeter. The heaters in a 12AU7 are connected to pins 4 and 5. It's designed for 12 volts across these pins. However, the heaters are center-tapped and the tap is connected to pin 9. With this feature, 4 and 5 can be tied together and, by using pin 9, the 12-volt tube becomes a 6-volt tube—actually two 6-volt heaters in parallel.

Checking the circuit, I saw that the socket was wired for 6-volt duty (see diagram). The ohmmeter showed the 5 to 9 leg intact—only the 4 to 9 portion had opened. Somehow, the full heater current had tried to go through one leg instead of dividing equally between the two.

Connections at pins 4 and 9 had to be okay—they were passing current. This



KEY TO THE MYSTERY in Pete's TV lay in the two possible ways a 12AU7 can be connected. His was wired for six volts (at left).

left pin 5 as the prime suspect. With the ohmmeter, I checked continuity from the top of the socket to the bottom lug where the wires are connected. To my amazement, it was good. I jiggled the probes—

[Continued on page 234]

Armrest bench



Take your pick—

A Pair of Modern Storage Benches

IN TODAY'S homes, a large piece of furniture must earn its space. That's why these benches are designed for double duty: Each gives you a spacious, sturdy seat 18" high and each provides generous storage for awkward-size items you never know where to keep.

The construction is similar for both: a wood frame faced with hardboard.

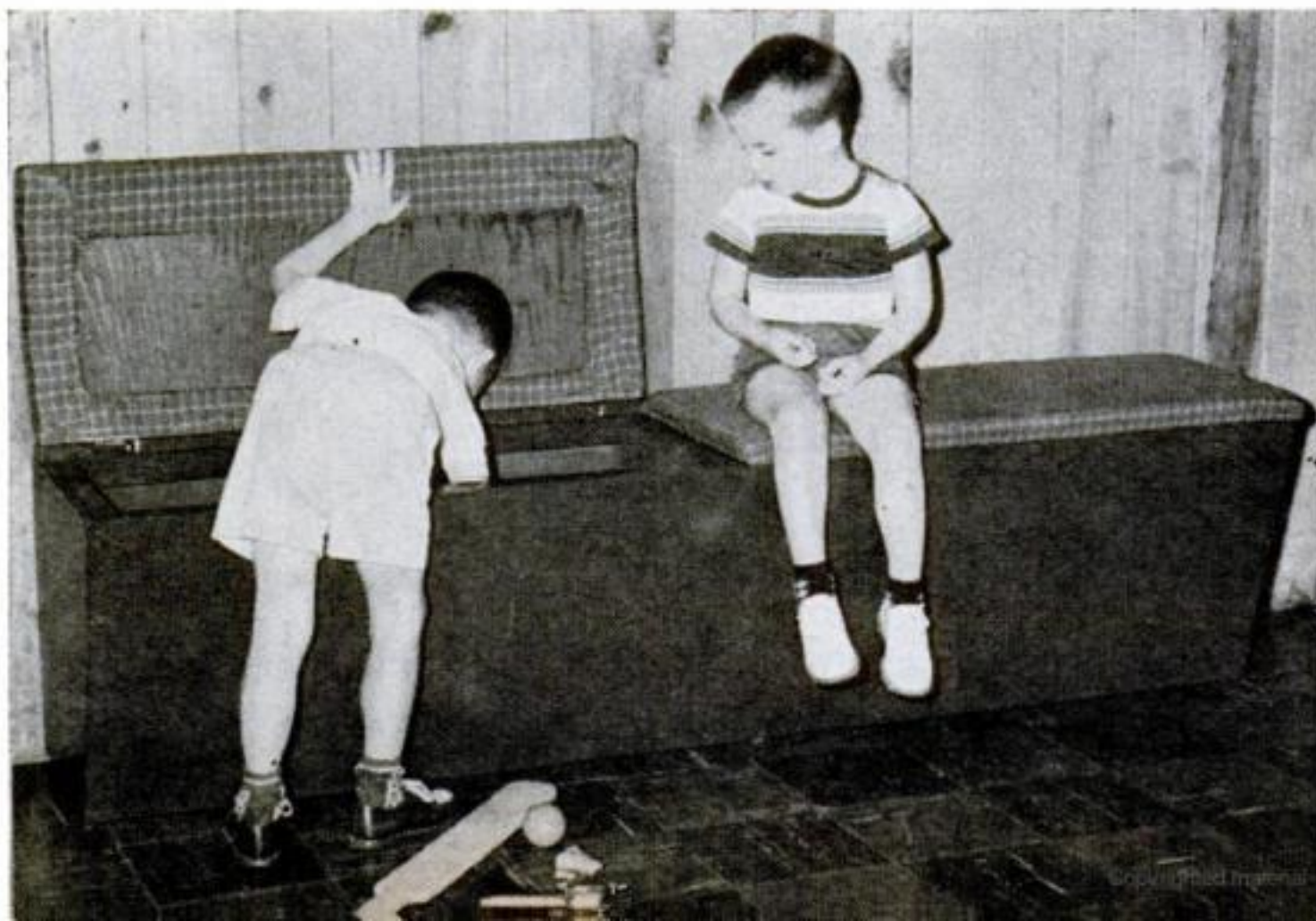
The cushioning is latex foam rubber.

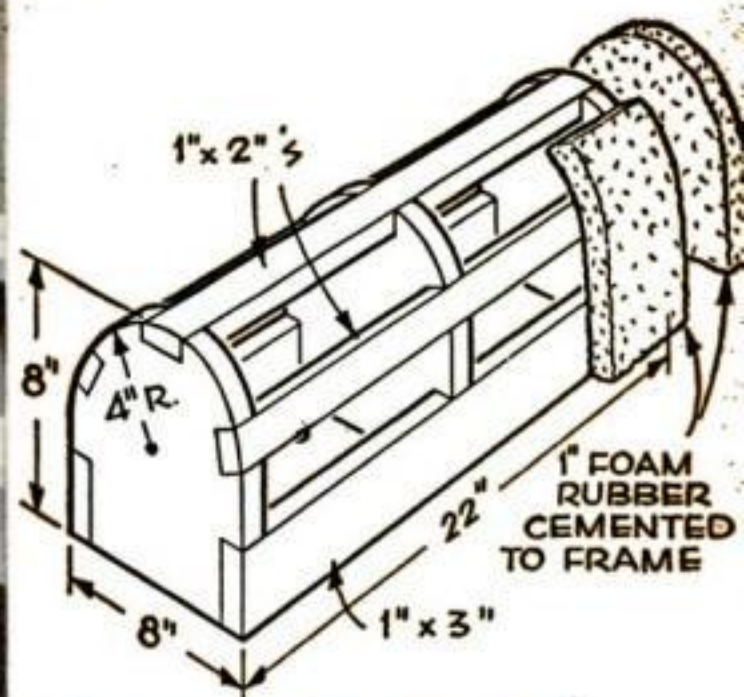
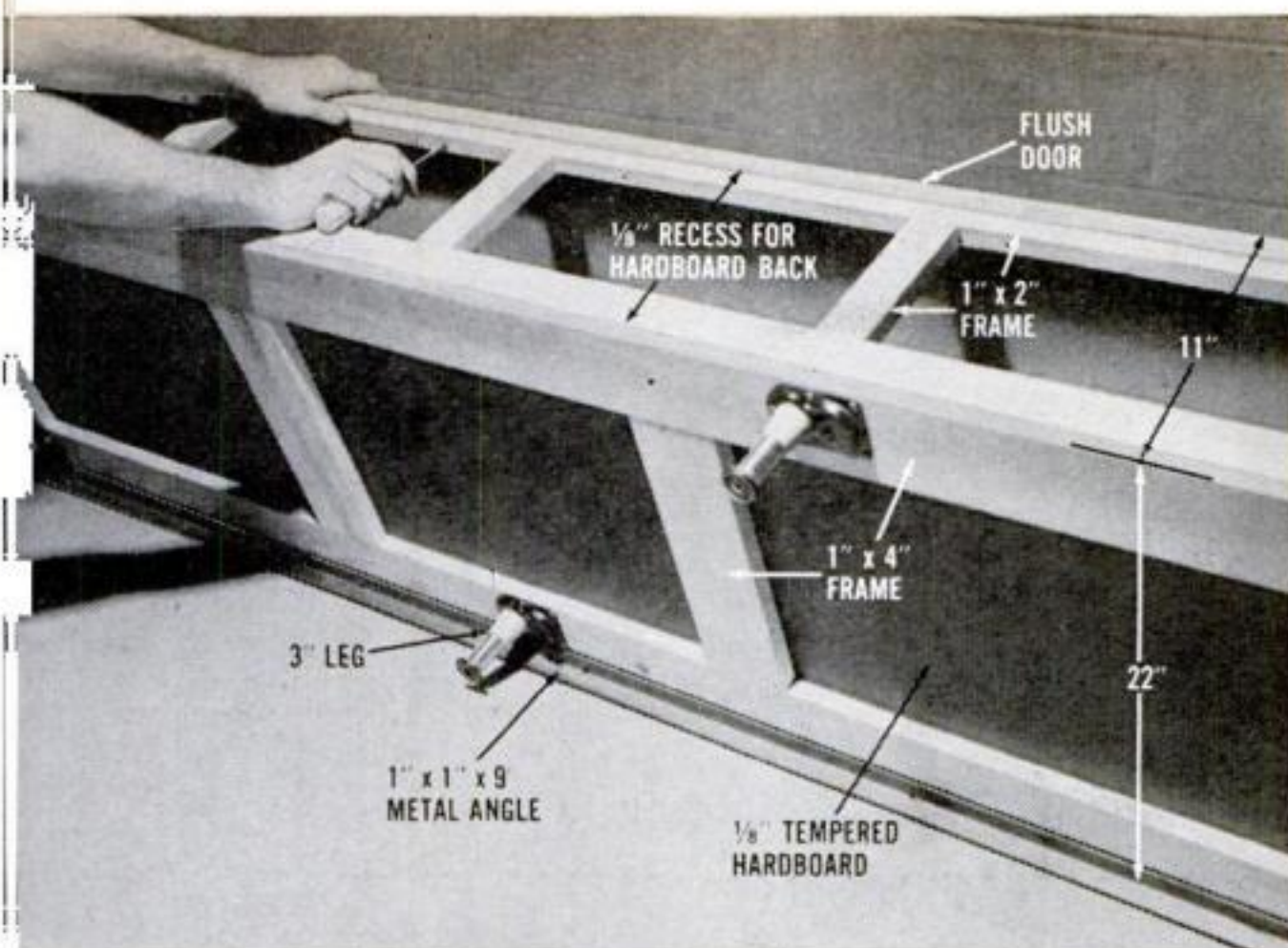
The double-bin bench with hinged lids would be a practical addition to a rum-pus room. There's more than five cubic feet of storage space in each bin.

The bench with attached cabinet is actually a slab sofa, with loose cushions supported by a 24"-by-80" flush-door panel. The split seating accommodates

Double-bin bench

FRAMES at top and bottom are joined by nailing end assemblies between, first drilling holes down through lap joints (right). Cut ends of slanted uprights at about 76 degrees. Use plywood lid of bin as pattern for marking latex slab. Cut it with scissors, leaving $\frac{1}{2}$ " extra on all sides. Put rubber cement on both lid and slab. Stretch upholstery fabric across foam, staple under lid.





ARMREST BOLSTER can be custom-made in various ways. A foam-padded wood frame gives firmest support. Plastic upholstery fabric to match cushion covers can be fitted over foam.

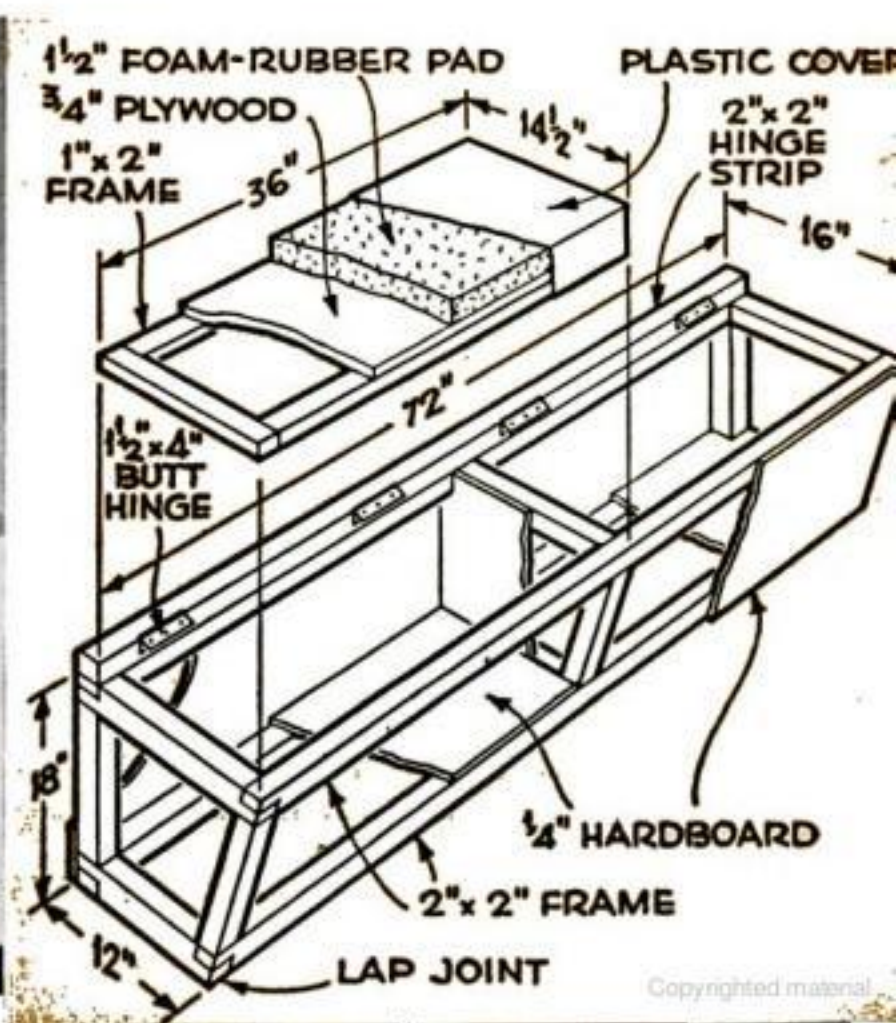
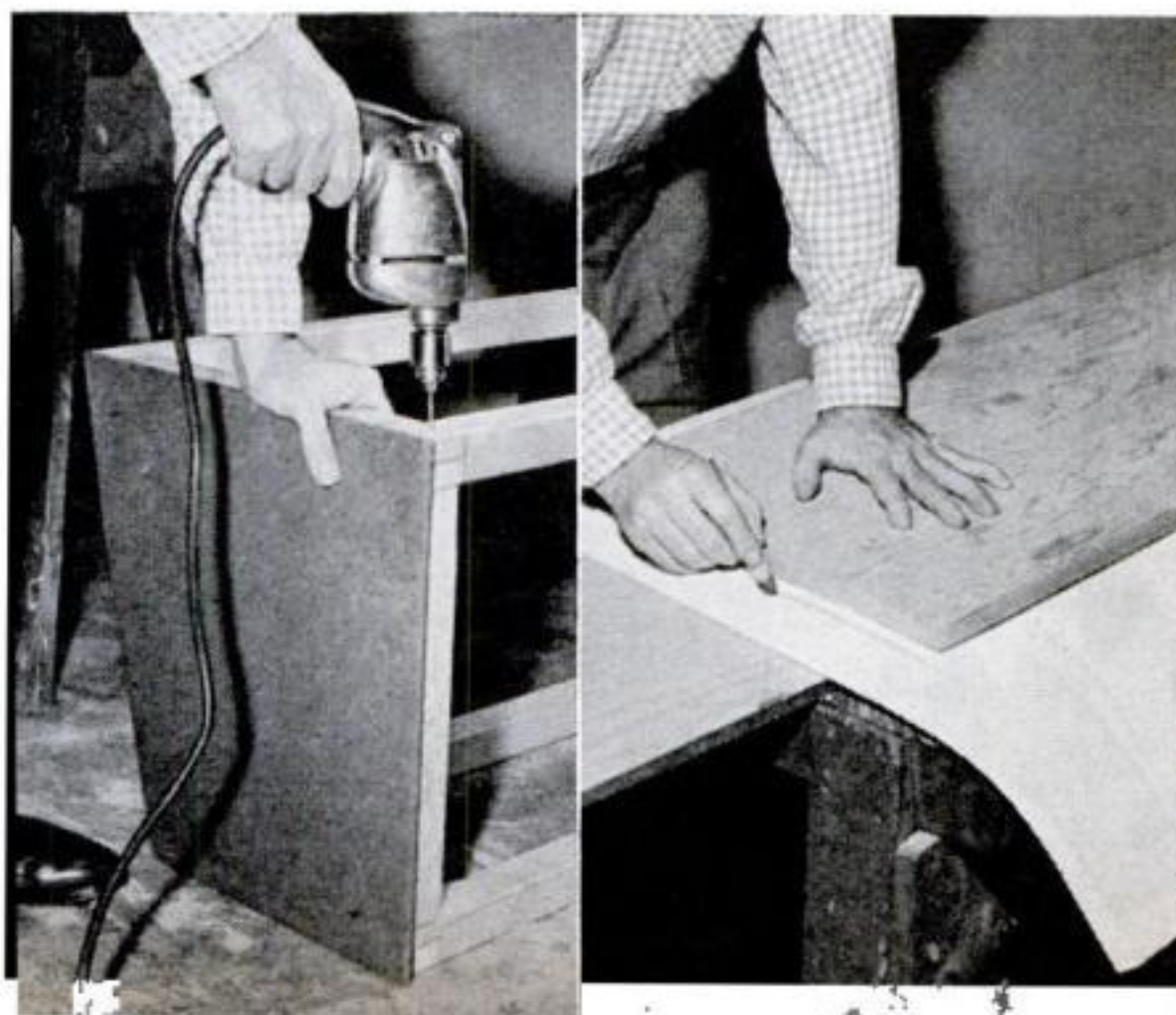
BACK VIEW OF BENCH CABINET shows how door panel is attached by driving screws up through frame. Angle iron along front edge is for rigidity; hide it with a 1/4"-by-2" pine apron.

four people; the armrest is removable.

Though it involves more construction, this bench, like the double-bin, requires little cabinetmaking skill. The lighter frames can be assembled with butt joints and corrugated fasteners. The side cabinet, 24" high by 36" wide, may be built into either end of the sofa. The model shown is topped with a panel of marble-patterned Marlite, a plastic-surfaced hardboard. This is set into rabbets on the inside edges of a one-by-four hardwood frame which has a center rail for extra support. A cabinet shelf is optional.

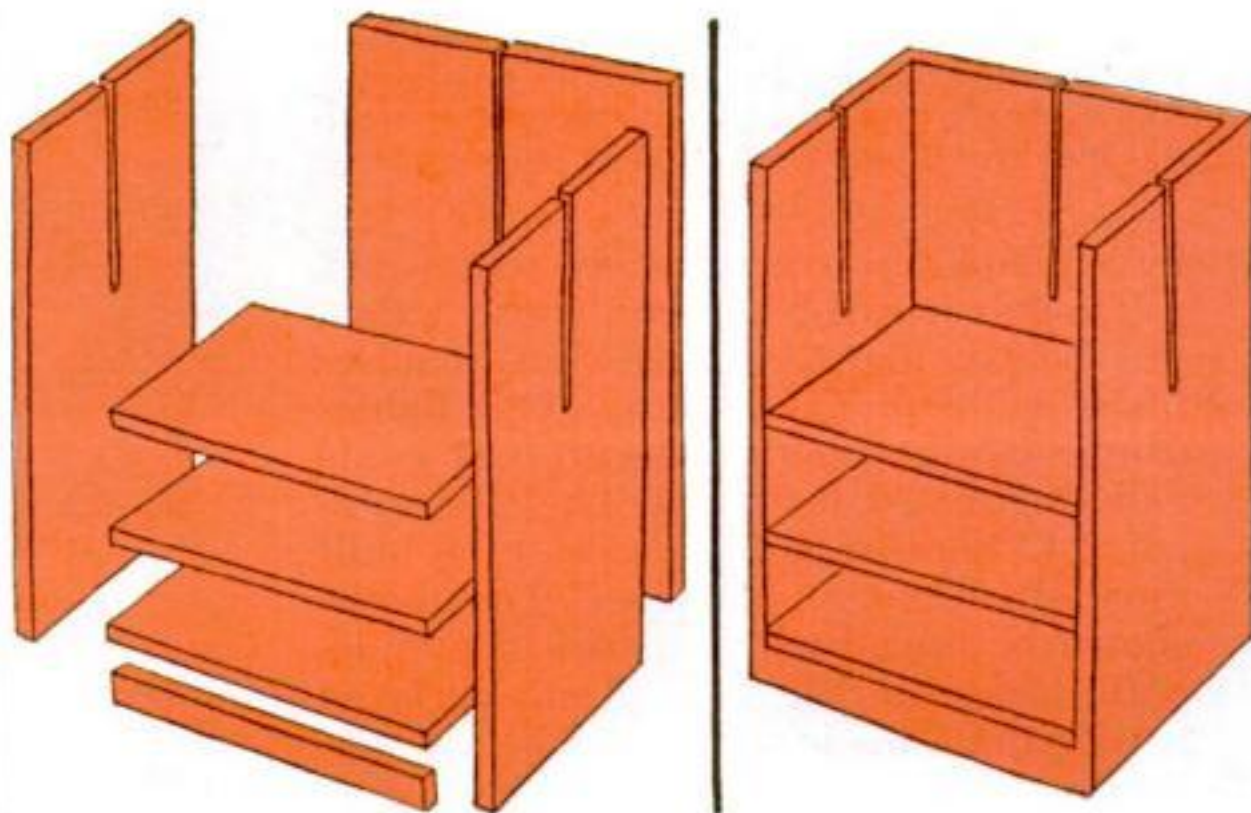
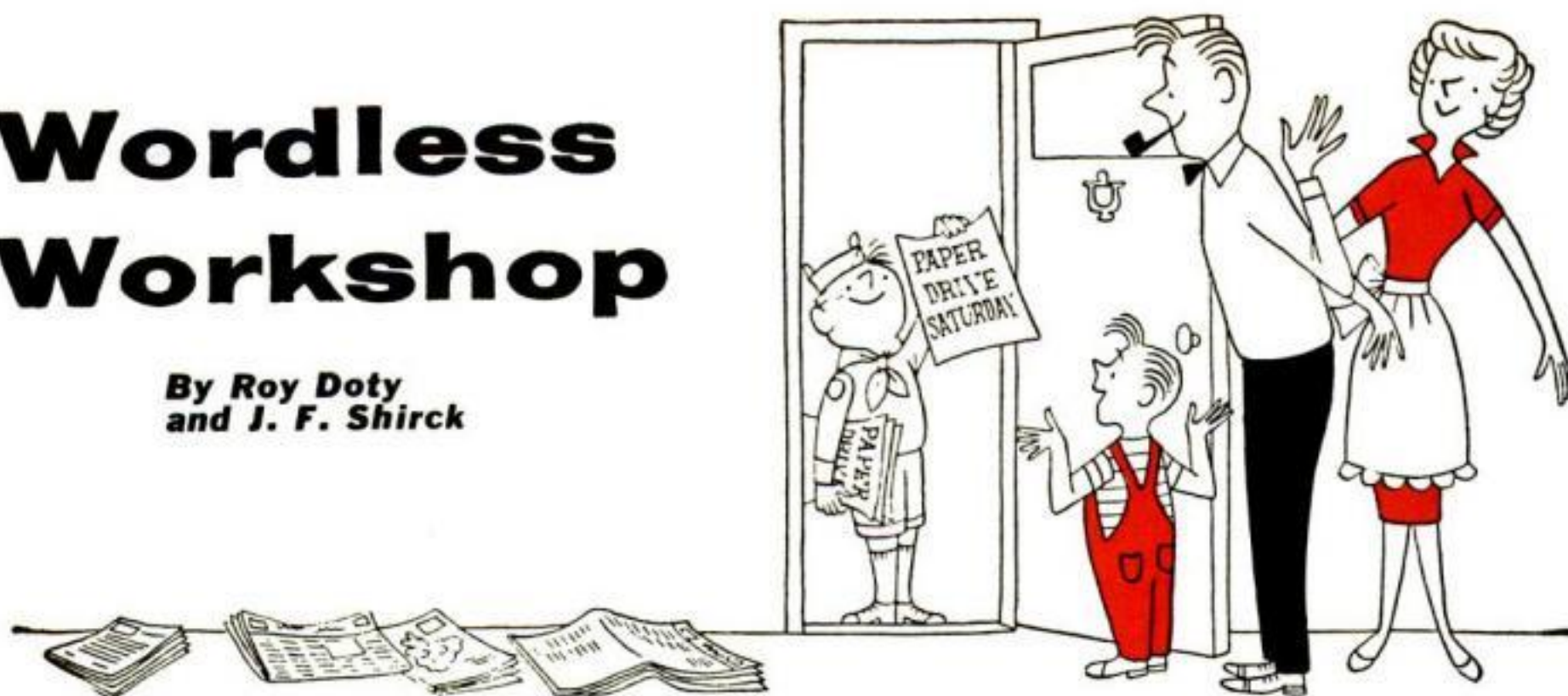


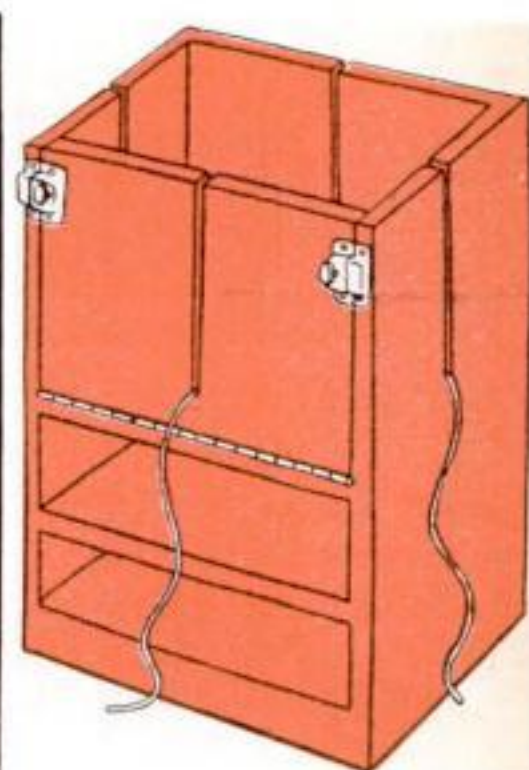
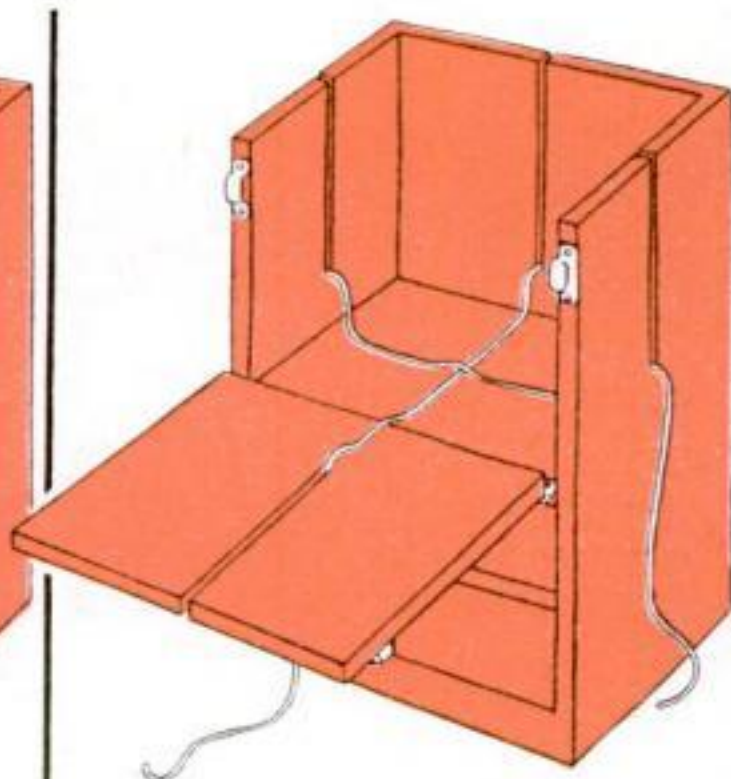
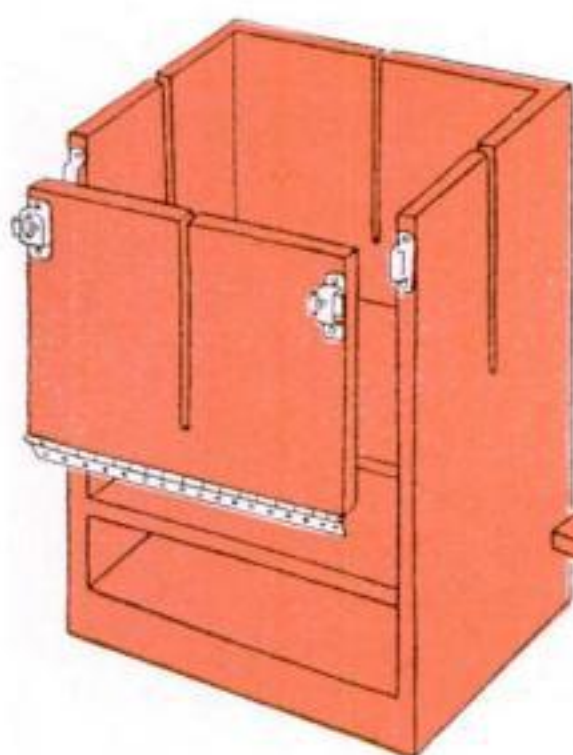
GENEROUS UNDERSEAT STORAGE is ideal for broad, flat game boxes, scrap books, and albums. If space has no partitions, put a 1 3/8" support dowel behind each sliding-panel overlap.



Wordless Workshop

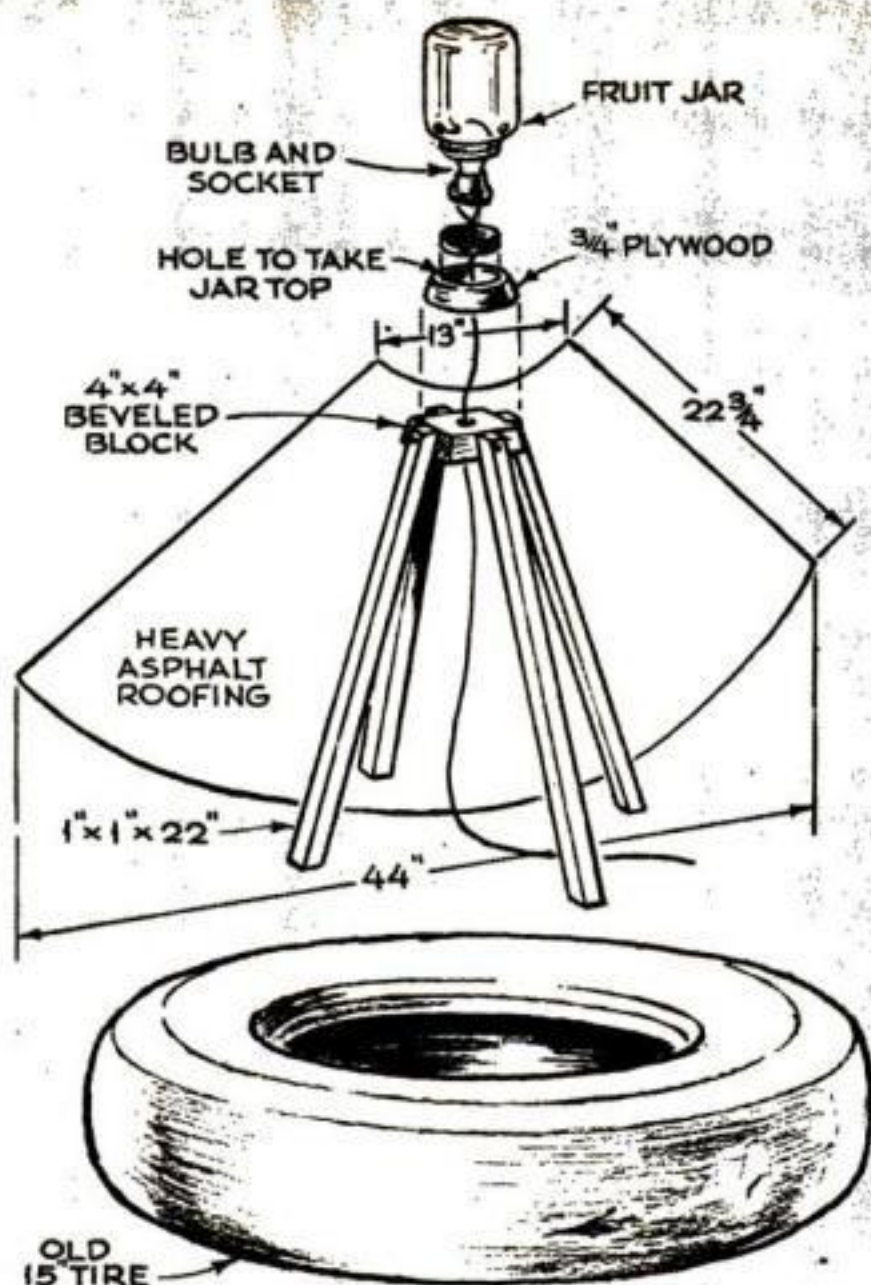
By Roy Doty
and J. F. Shirck





Short Cuts and Tips

FROM PS READERS



Homemade Airstrip Marker Costs only \$1

SINCE commercial markers sell for at least \$30 apiece, many private and small-town airfields have had to go without landing-strip lights. This design, created by Henry Grawunder, young flying enthusiast of Bellville, Tex., brings markers within any budget: Excluding wiring, materials cost under \$1.

A \$3.50 or \$4 roll of asphalt roofing makes "flared skirts" for about 15 mark-

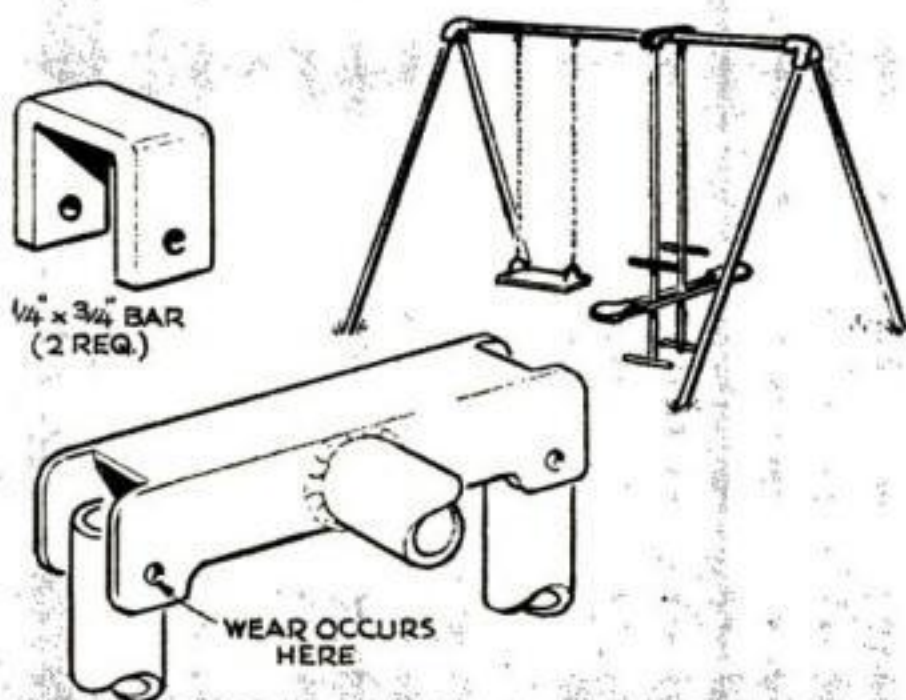
ers. Each skirt is stapled around a frame which is then wedged inside an old tire. This weighted cone is able to resist winds of more than 50 m.p.h.

Skirt and tire are painted yellow for daytime visibility and a wide-mouthed fruit jar houses a bulb and socket for night lighting. Air holes drilled through the glass prevent frost formation inside.—Orlan Jones, Bellville, Tex.

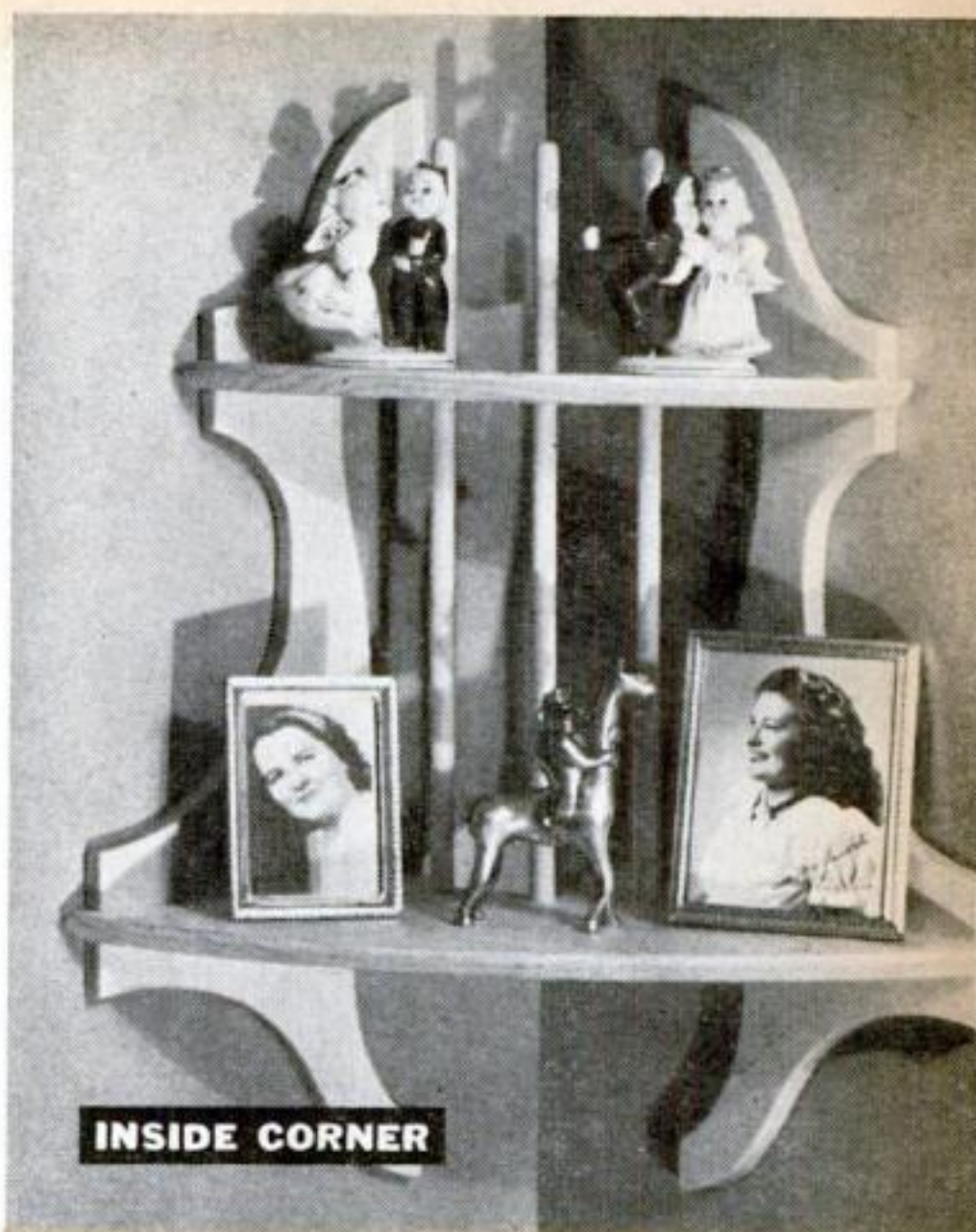
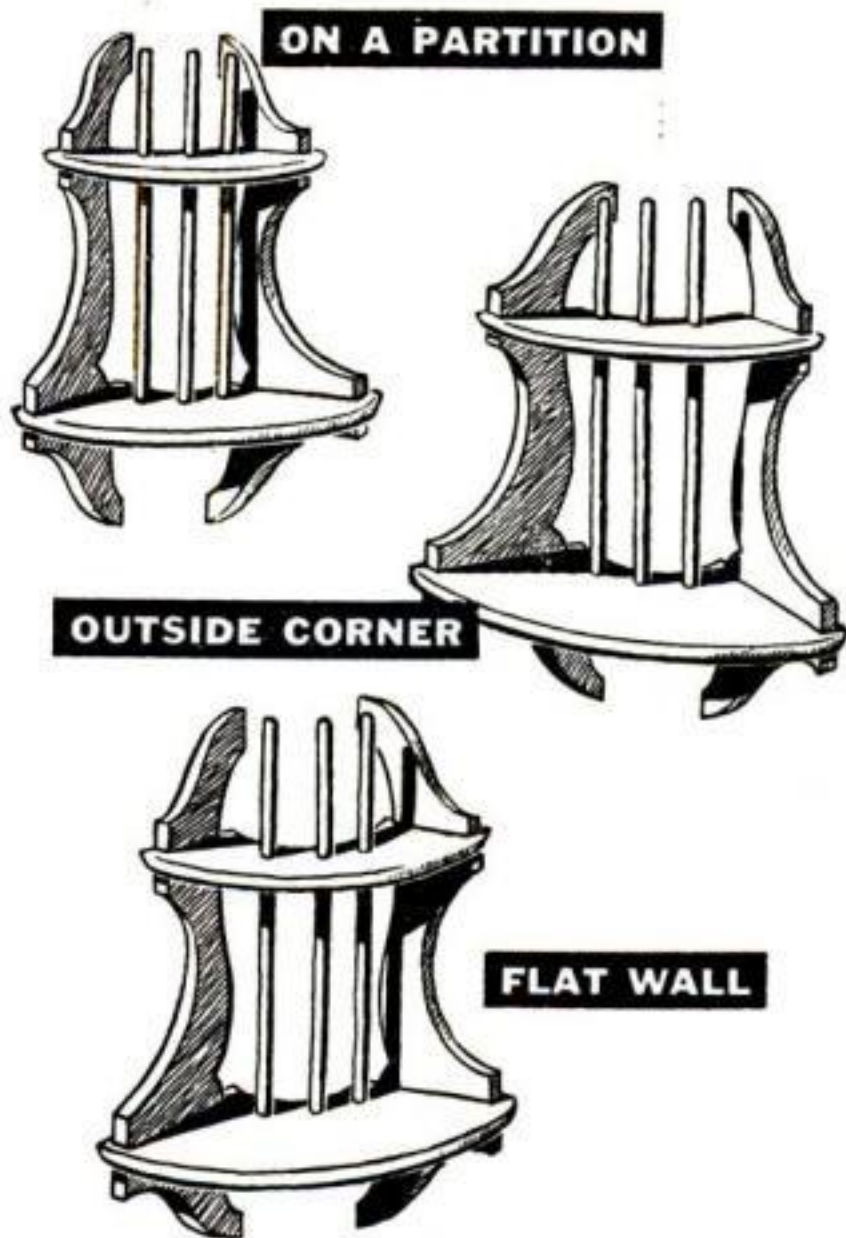
Repairing a Worn Swing

AFTER a summer's hard use, the pivot holes in the support arm of my children's glider were badly worn. I was afraid the metal might break through, letting the glider fall. To put the unit back into safe service, I bent a pair of yokes from 1/4" steel bar, to fit snugly over the pivot channel, and drilled new holes to align with the old ones.

No welding was required; I just used longer cap screws as pivot pins, securing them with lock washers and double nuts.—John G. Voelker, Timonium, Md.



A Shelf You Can Hang Anywhere . . .

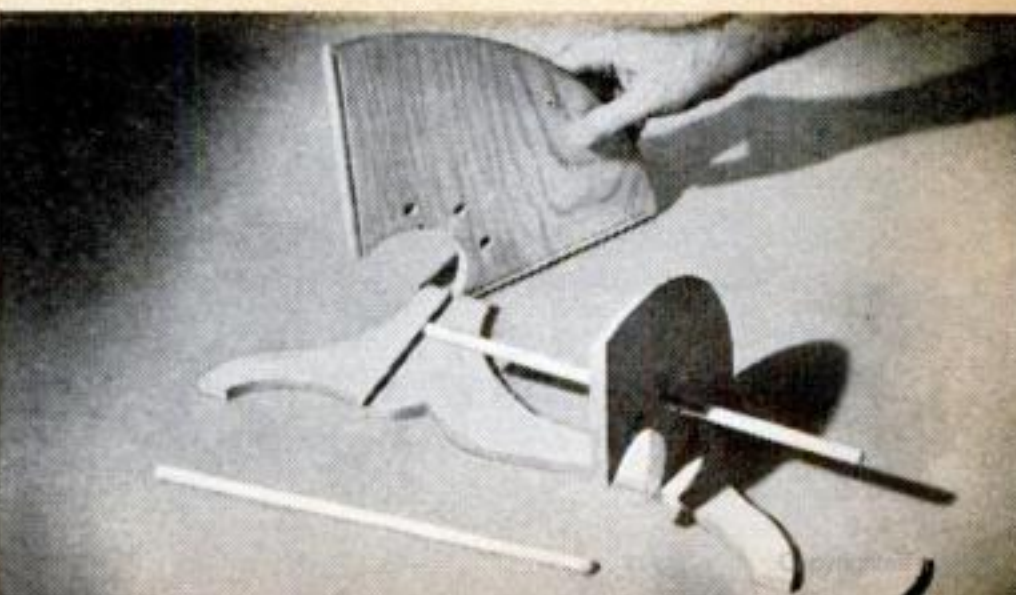
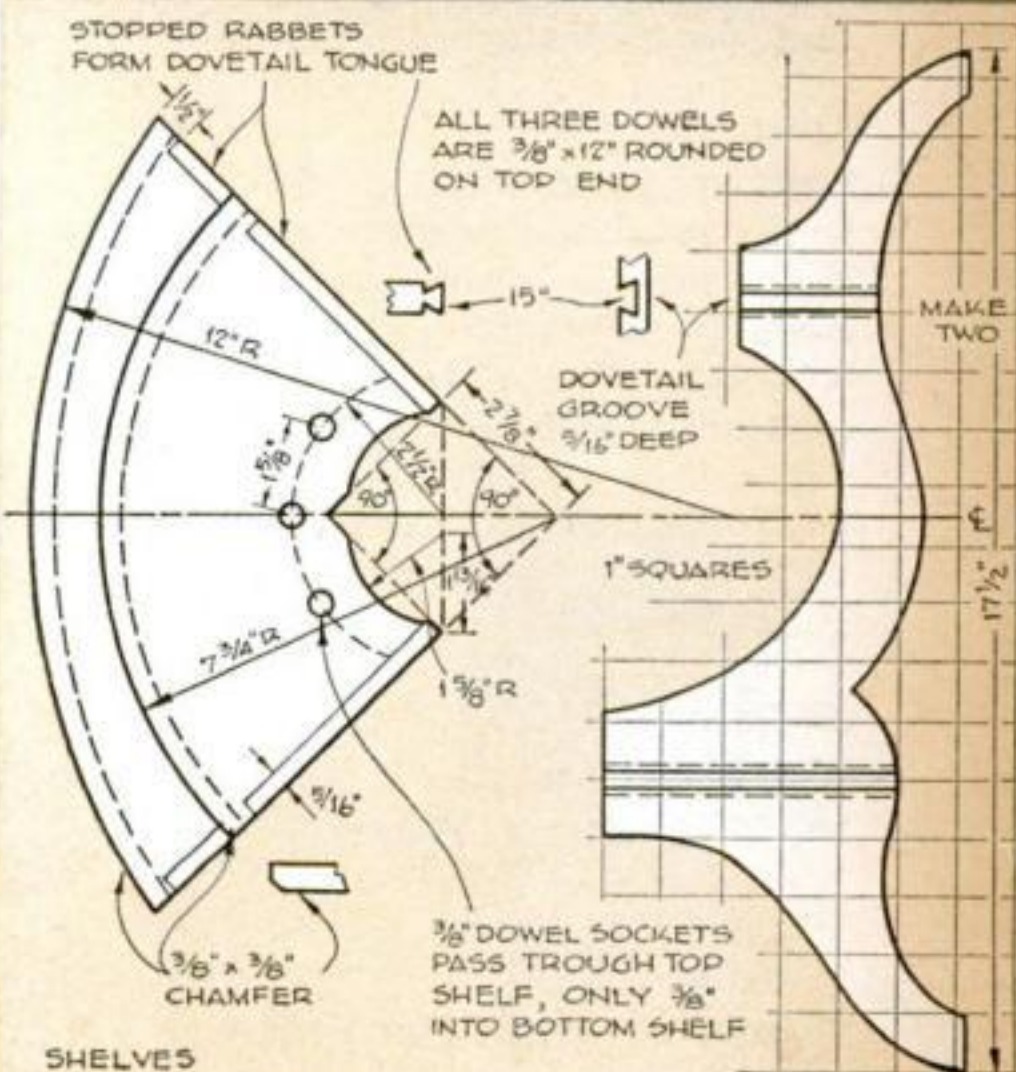


JUST another knick-knack shelf? Look again. This ingeniously modified lyre design slips together like a Chinese puzzle to create the most versatile wall shelf you can make. Its sliding-dovetail joints let you adjust it to fit any location—including a few spots you've probably never considered hanging a shelf.

Lay out the four flat members on $\frac{1}{2}$ " stock. The grooves in the sides are best cut with a $\frac{1}{2}$ "-by- $\frac{1}{2}$ " router bit—before the blanks are tacked together and shaped on a band- or jig-saw. Cut the front radius of each shelf, chamfer the underside, and shape the stopped dovetail tongues. Tape the shelves together so you can drill the dowel holes and saw the rear-edge design of both at once.

—Abraham A. Stein, Brooklyn, N.Y.

ASSEMBLE WITHOUT GLUE OR BRADS. Dovetails should have snug, smooth fit. With chamfers down, insert both shelves into one side. Then slip on other side and run dowels into sockets.



Short Cuts and Tips

FROM PS READERS



Underwater Flashlight

SOMETHING fall overboard? You can hunt for it on the bottom of the lake with this emergency lamp. Turn on an ordi-

►►►USE green lumber, rather than seasoned wood, for concrete forms. Dry lumber tends to draw moisture from the concrete. If you can't find green boards, coat the dry ones liberally with old crankcase oil.—*M. Robert Beasley, Detroit.*



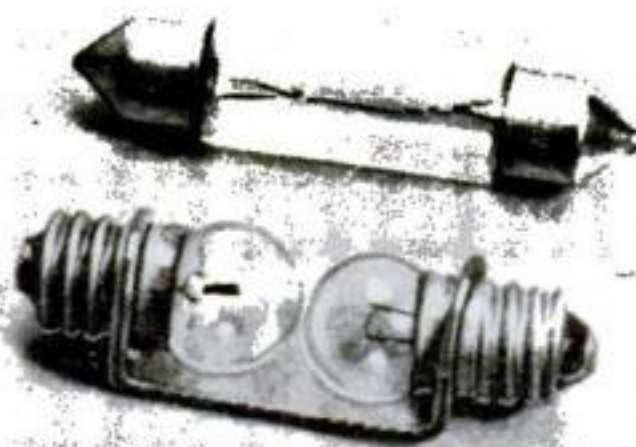
Feet for Small Projects

PLASTIC caps from tubes and miniature bottles make neat, modern-looking feet for small projects. The ones shown are toothpaste caps attached with small screws through holes drilled in the concave top. For bottle caps, screw small sections of dowel under each corner of the project and glue or force-fit caps over them.—*Frank A. Javor, North Bergen, N. J.*



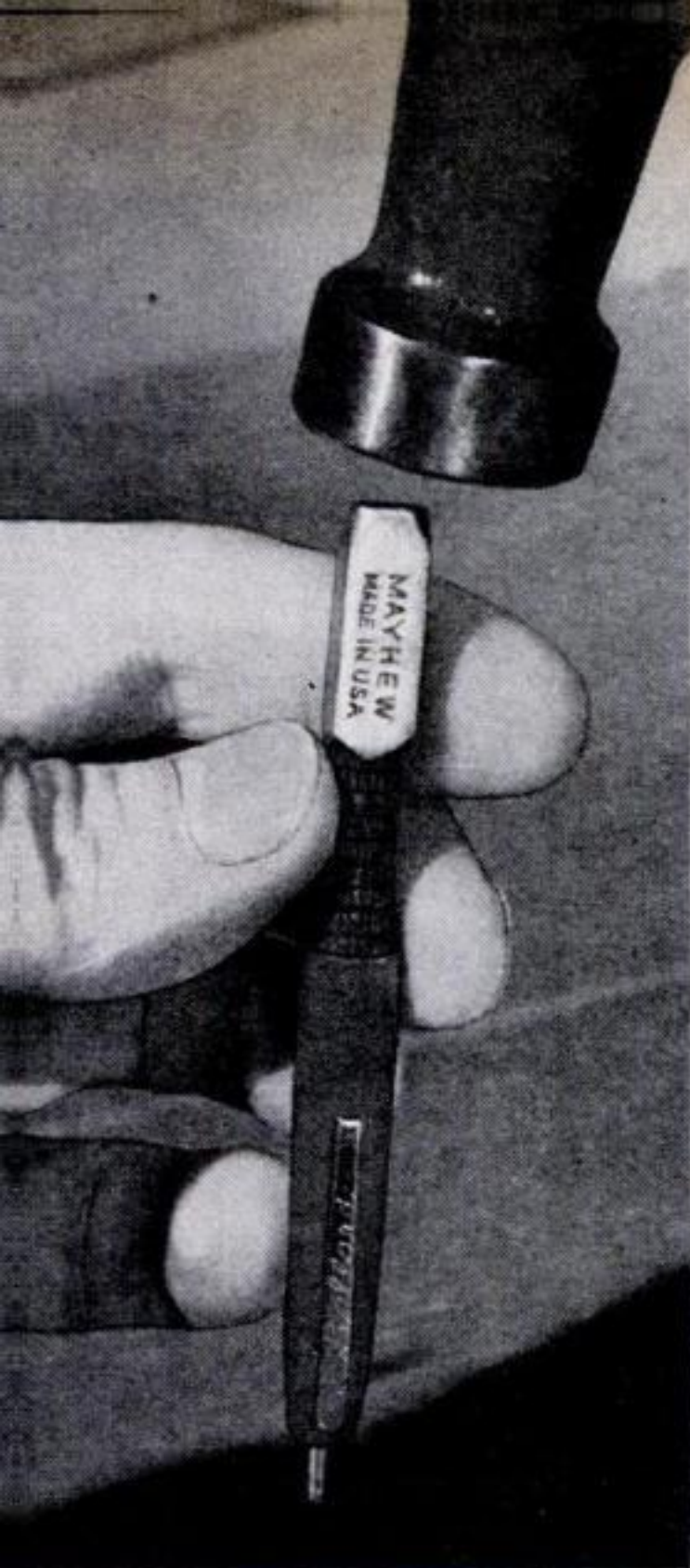
nary flashlight and seal it tightly inside a glass canning jar. If it's necessary to keep the jar submerged, put a heavy weight in the jar or tie it to the outside.—*Charles Carroll, Marion, Ohio.*

►►►You can strip rubber insulation from the ends of electric wire better with a moistened knife. Dipping the blade in water or stroking it across a wet sponge helps it slice through the rubber more effectively.—*John W. Nestler, Tampa, Fla.*

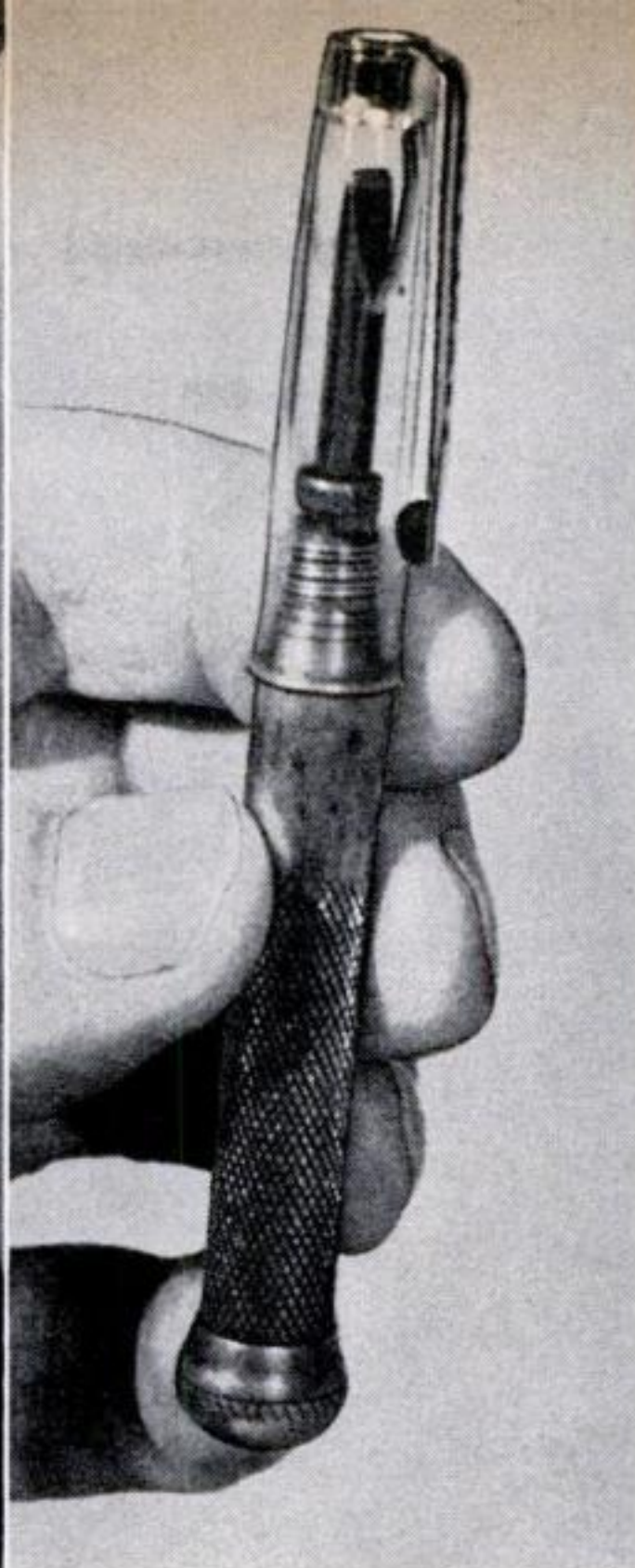


Replacing Bulb in a Foreign Car

IMPORTED cars often have a fuse-type bulb for interior lighting. Replacements aren't always easy to find. Here's a good substitute: Bracket two screw-base flashlight bulbs together with a paper clip or stiff wire. If the tubular bulb is six volts, use two three-volt round bulbs. For a twelve-volt system, use six-volt bulbs.—*Robert Micals, Freehold, N. J.*



CARRY A NAIL SET in your pocket? Press a pen cap down over the point—until the point pokes through. There's no need to remove the cap to use the set.



POCKET SCREWDRIVER to fit a pen cap can be found in hardware and department stores. The one above has a hollow handle with several blades.

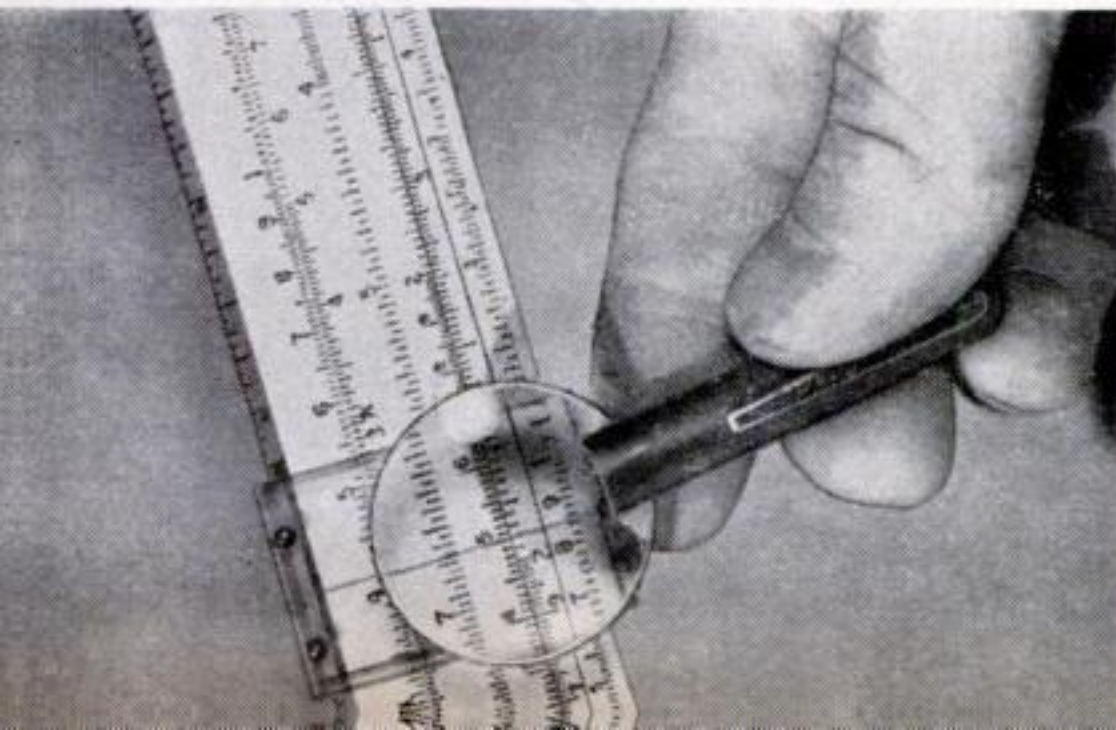


A TYPING ERASER of the pencil type needn't be thrown out when it gets stubby. Add a clip cap and you have a pocket brush for cleaning a camera.

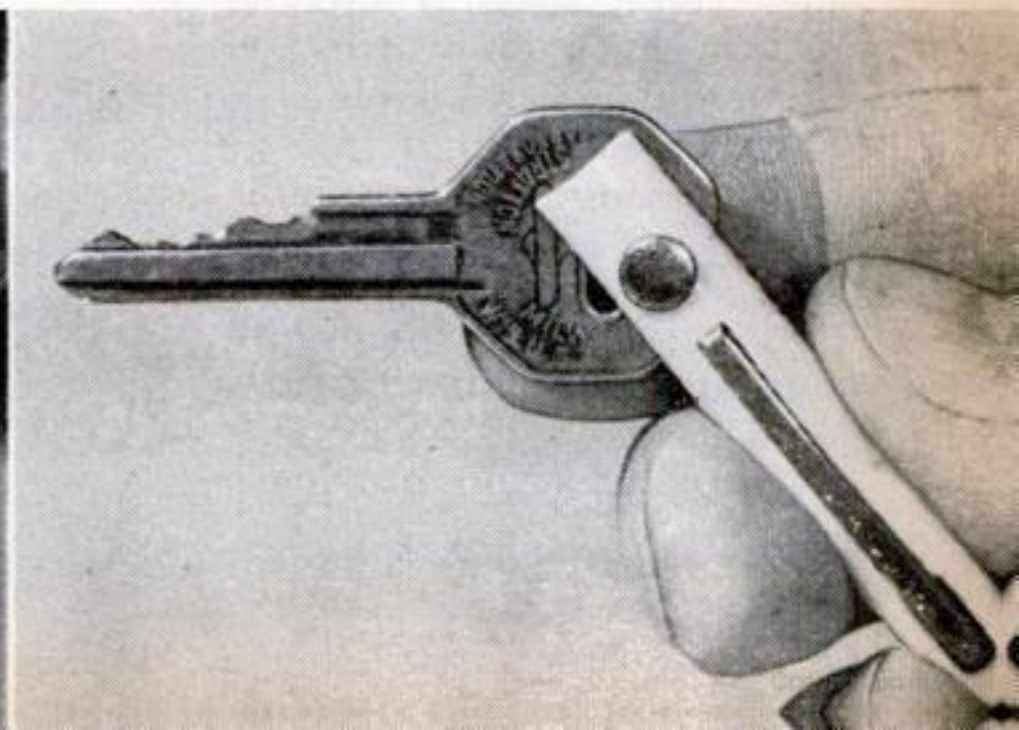
Clip It...AND IT'S HANDY

Discarding your ballpoint? Save the cap for new attachments

MOUNT MAGNIFYING LENS in cap by sawing slot across open end. Stuff paper below slot and fill flush with wood filler; then seat lens.



CAR-KEY CLIP: Press a wooden dowel into a cap, saw a deep slot, and drill a hole for a small bolt or rivet to retain the car key.



Jigs Make Lathe a Shaper

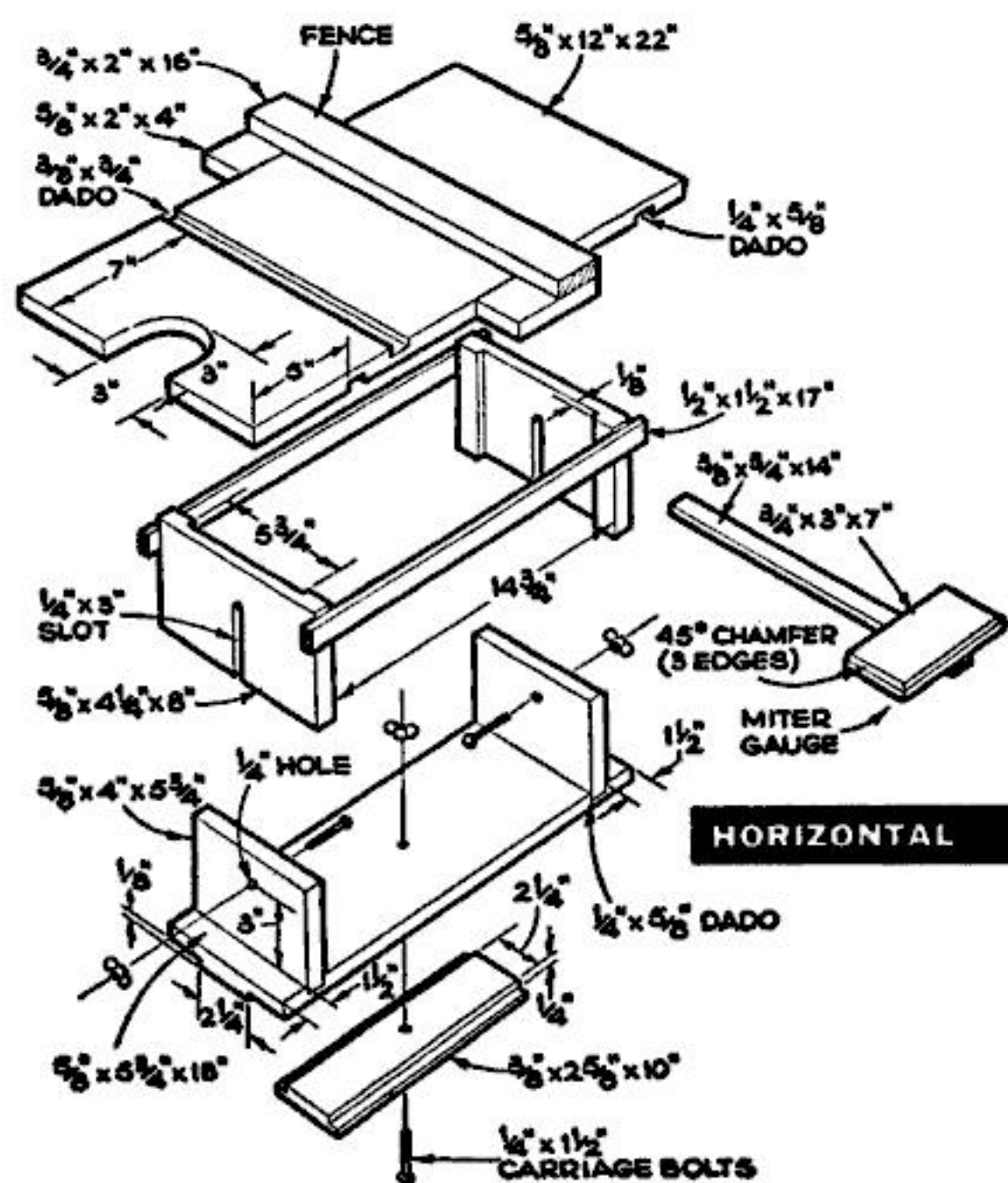
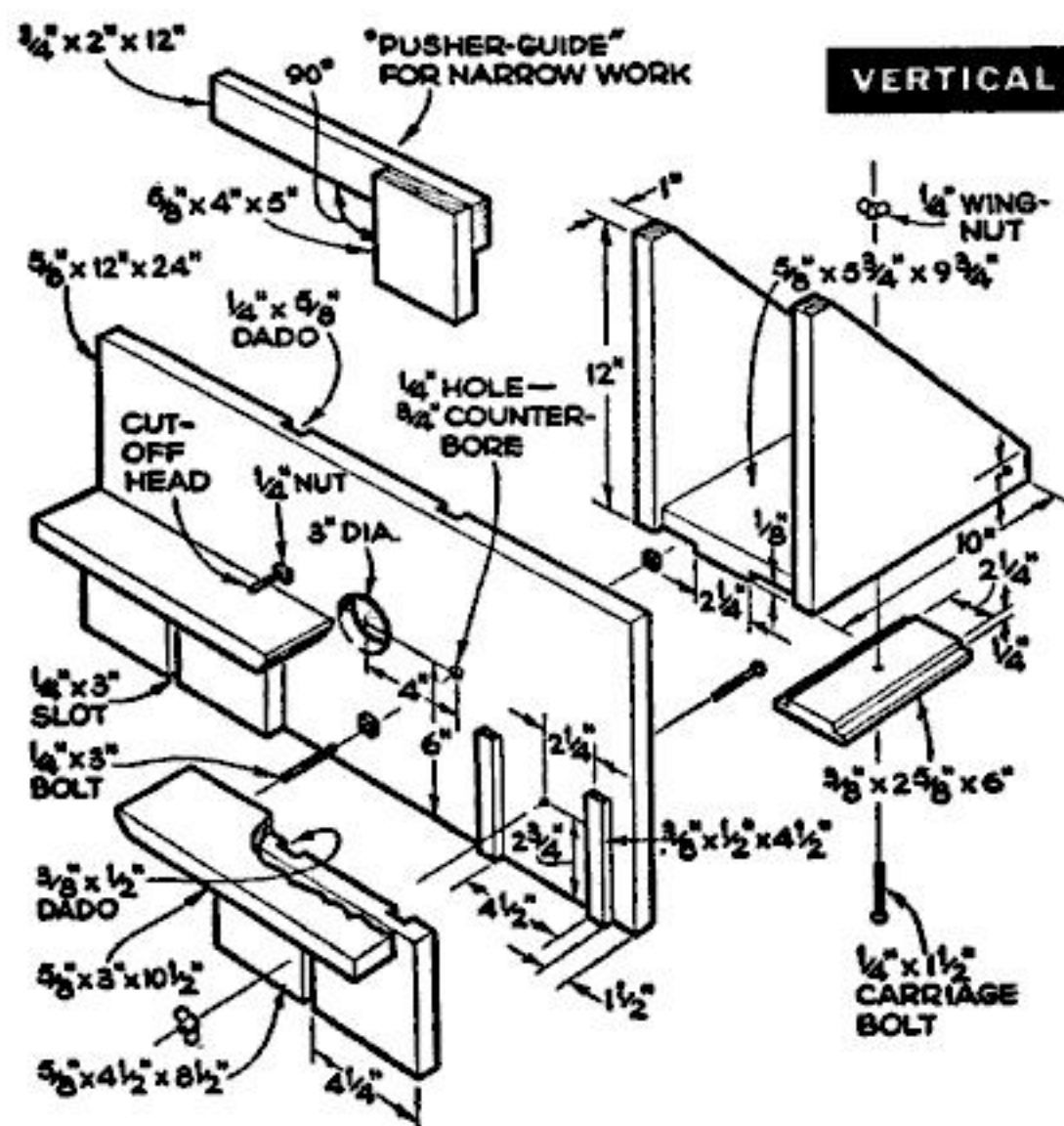
By R. J. De Cristoforo

WHEN you own a lathe, you also have the makings of a shaper. With a chuck spindle for mounting a shaper adaptor, plus one or two easily made jigs, you have an efficient set-up for producing decorative edges or doing such functional chores as forming tongue-and-groove joints. There is little a conventional shaper will do that can't be done here. In fact, there are some bonus operations, such as horizontal drilling and routing, that a shaper can't handle.

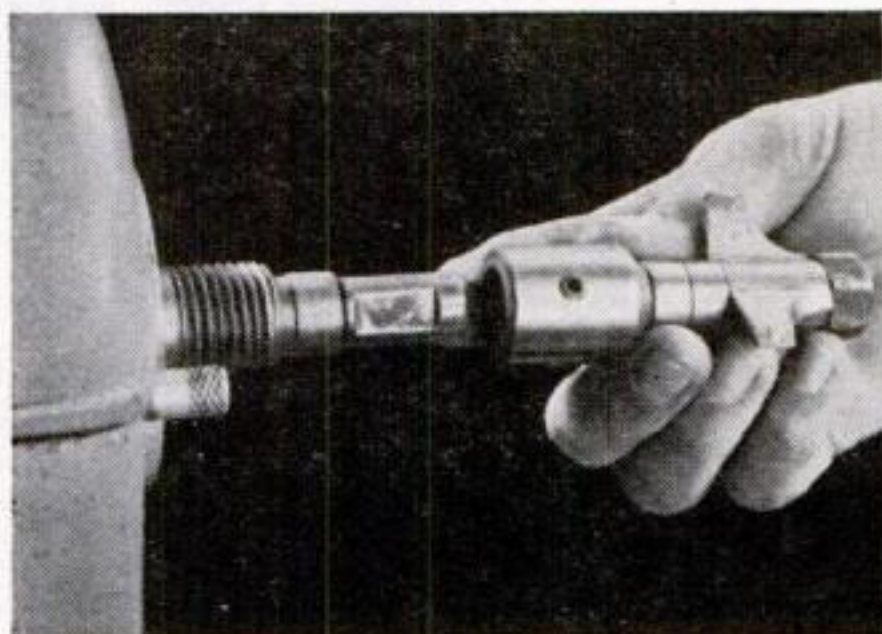
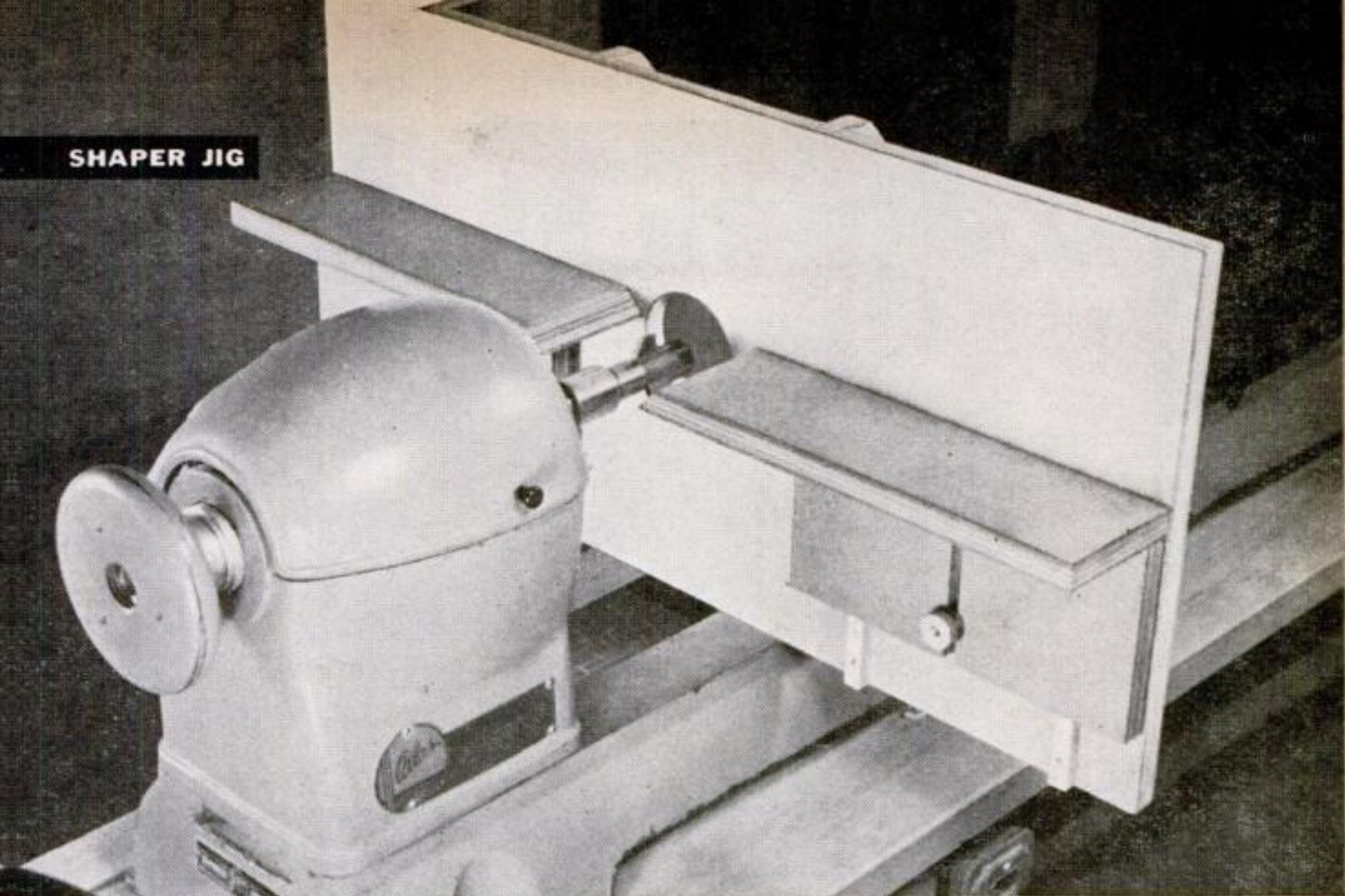
All you need to buy (in addition to cutters, of course) are a chuck spindle and a shaper adaptor. The type of spindle depends on your lathe. If it is equipped with a straight, unthreaded spindle, you can buy a shaper adaptor to lock directly to the spindle. If the lathe has a tapered hole, you'll need a tapered spindle chuck on which you mount the shaper adaptor.

Here's a hint: If a $\frac{5}{8}$ " straight, unthreaded spindle or a No. 2 Morse taper hole is involved, check a local dealer who handles the Shopsmith multipurpose tool for the parts you'll need.

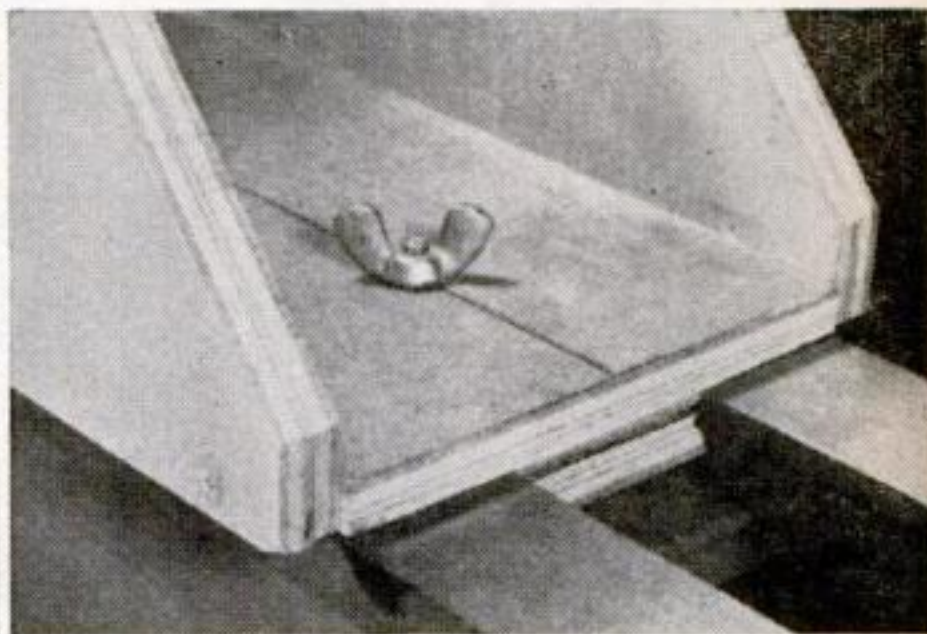
Most lathes will provide a



SHAPER JIG

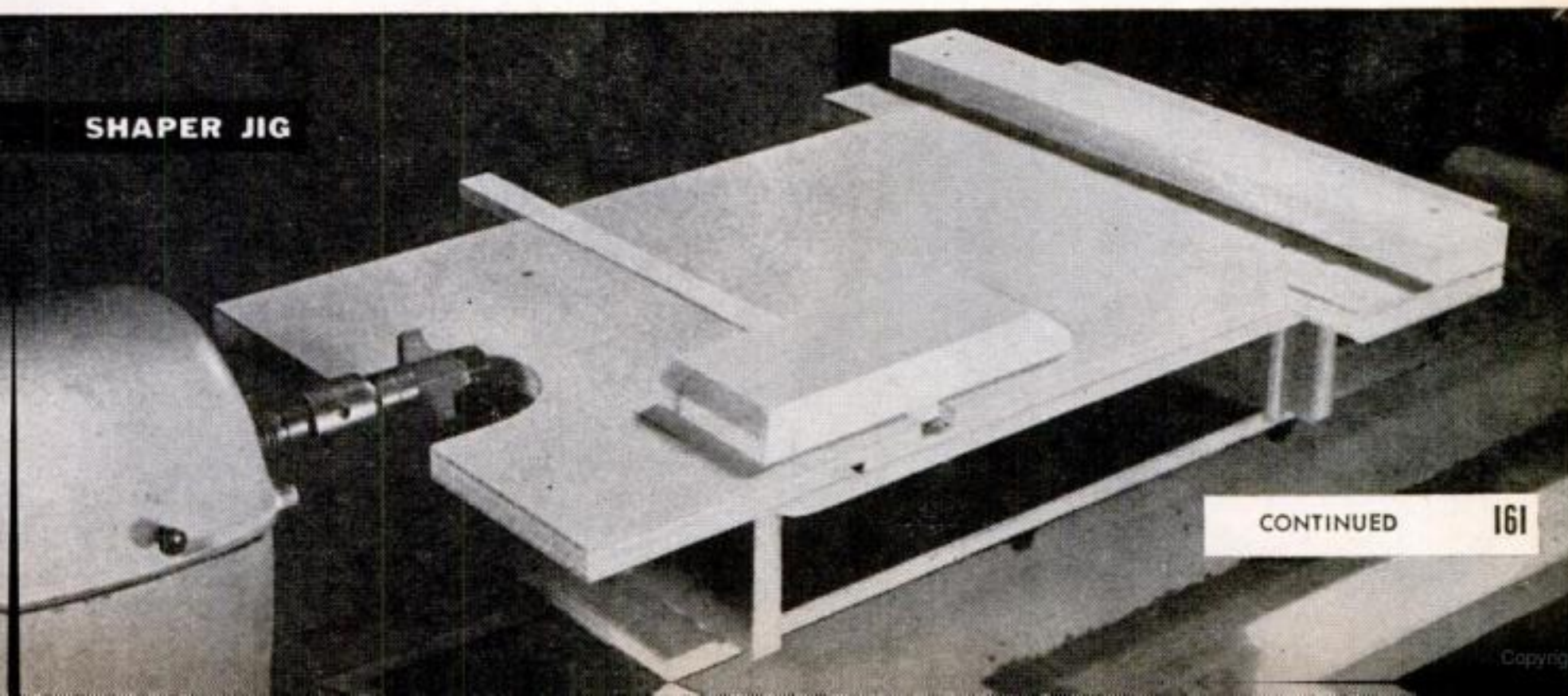


PARTS TO BUY are a No. 2 Morse taper spindle chuck and a shaper adaptor. If your lathe has a straight unthreaded spindle, you can get by with even less—just a shaper adaptor.



BOTH JIGS LOCK on the lathe bed the same way. Allow space between the slide block that fits under the ways and the jig itself. Wing-nut locks jig and block together and to lathe.

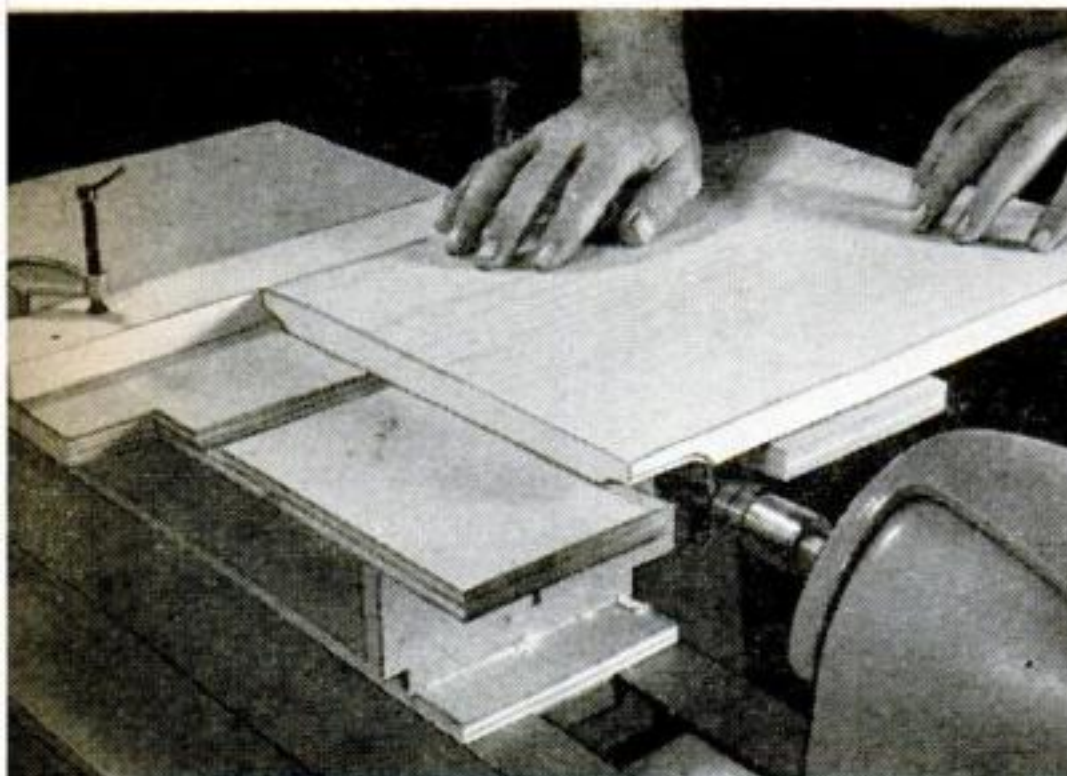
SHAPER JIG



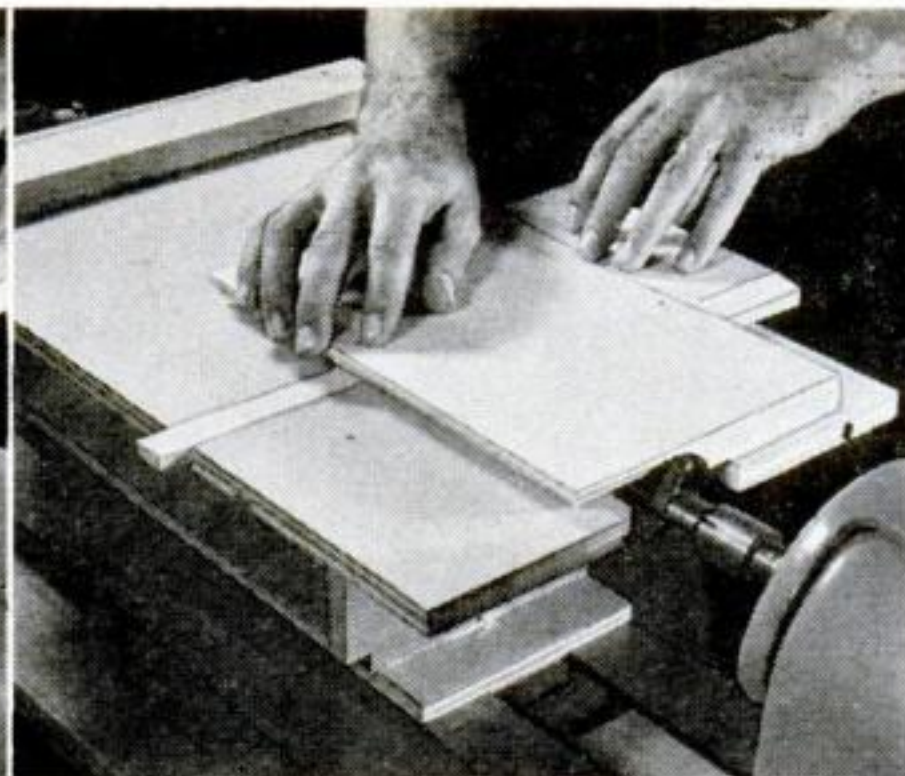
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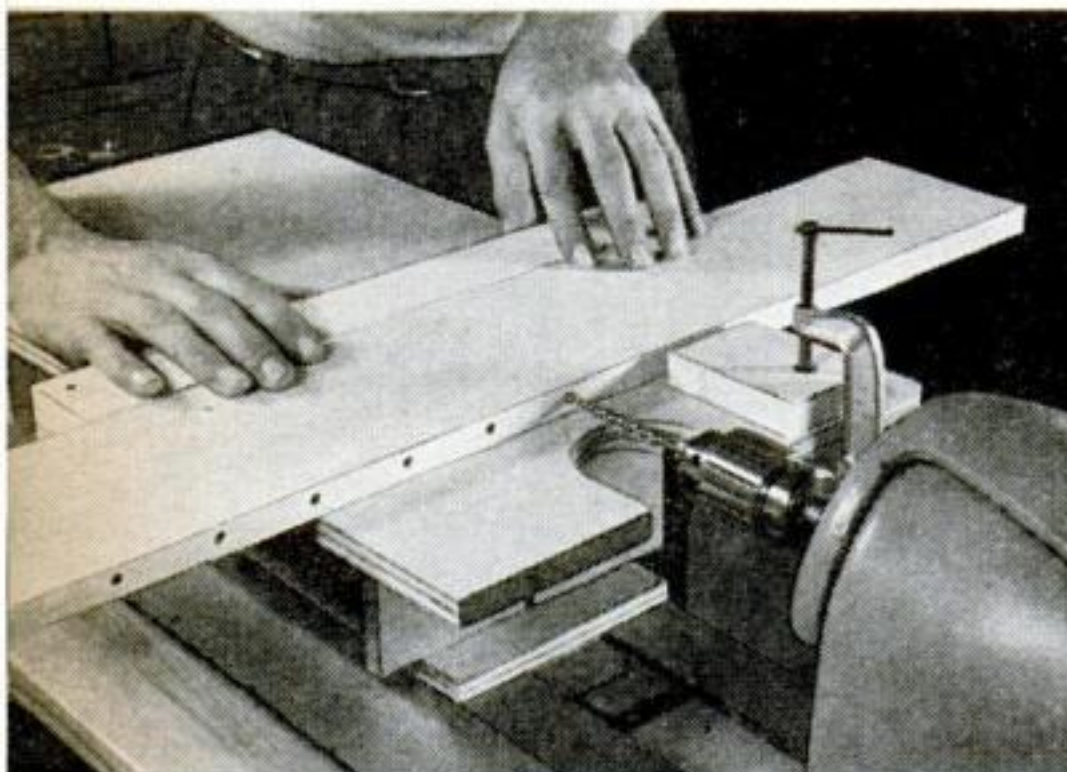
What you can do with the horizontal shaper jig . . .



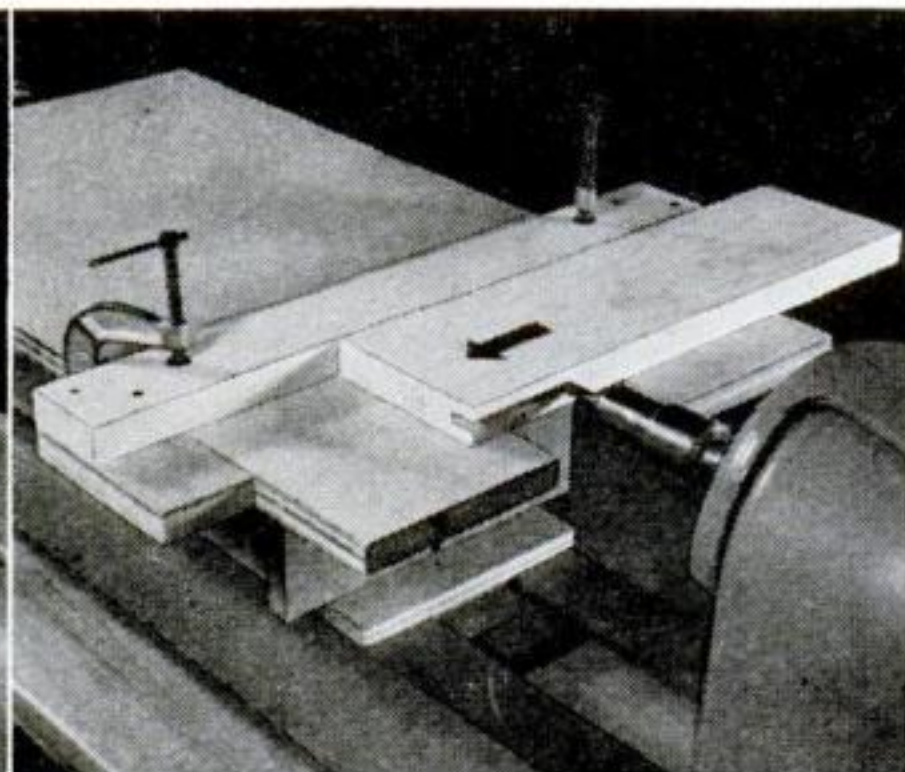
CLAMP FENCE IN PLACE for edge-shaping big work. Fence must be parallel with front edge of table; check its setting by measuring from each end of fence to front of table.



USE MITER GAUGE for cross-grain cuts. The cutter tends to move work away, so hold it tightly against the gauge head. In shaping four edges, do the cross-grain cuts first.

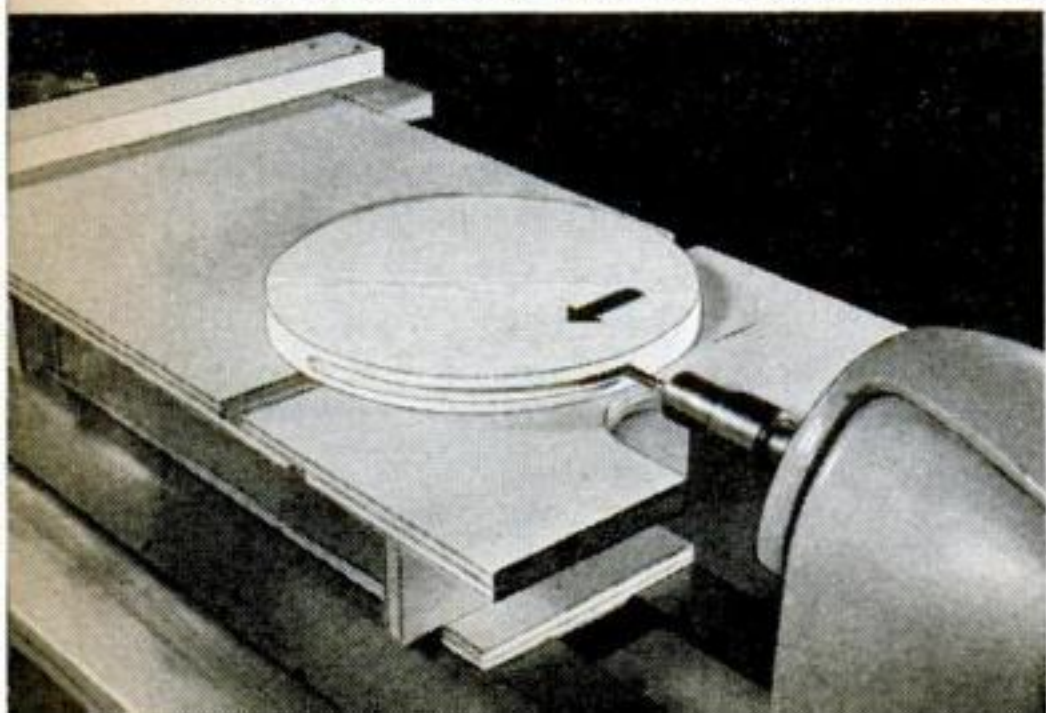


HORIZONTAL DRILLING makes edge-to-edge dowel joints a snap. Jig is locked in place, and both fence and work are moved into turning bit. Clamped block controls hole depth.



FOR ROUTING, use a router chuck that locks on spindle like the shaper adaptor. You can rout grooves, rabbets, round-end mortises, etc. Speed should be as high as for shaping.

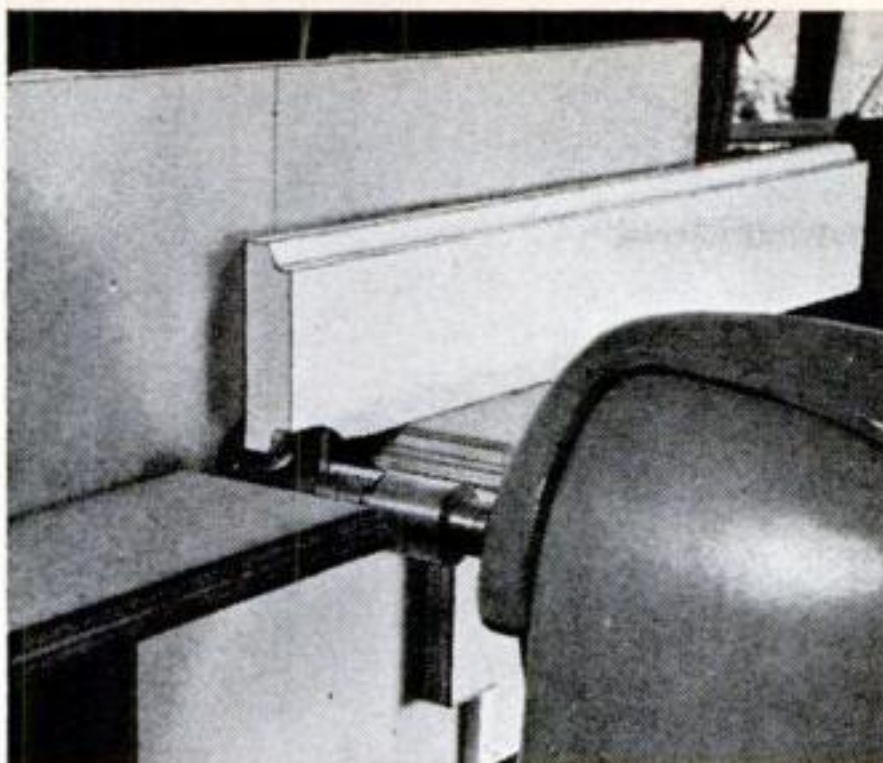
ROUT CIRCULAR EDGES by the pivot method. The pivot, a nail driven through work into table, should be on the spindle center line. Position the work, move the jig to engage the cutter, lock the jig, turn work to complete cut.



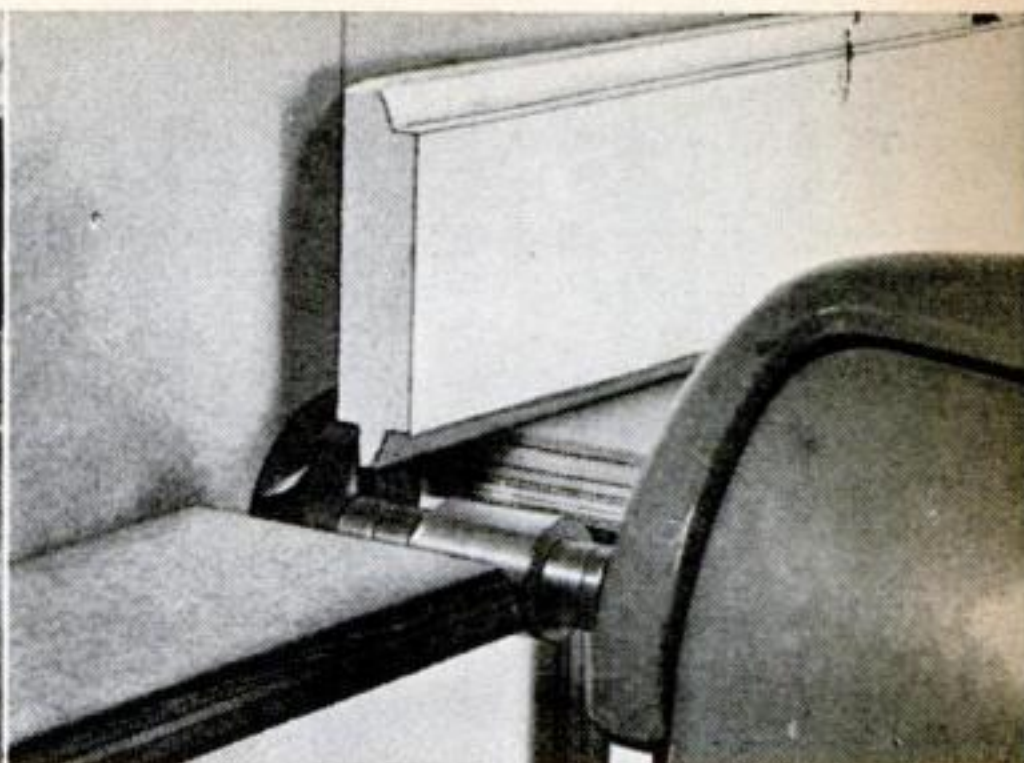
high speed of about 5,000 r.p.m. A higher speed is good for shaping, but 5,000 r.p.m. is adequate. Don't put on special pulleys to provide a special shaper speed unless you're sure the lathe is built for it. One way to compensate for slower speeds is to slow the rate of feed. This increases the number of times the cutting edges pass over any given area and results in a smoother cut. Don't take excessively deep cuts. Do it in stages.

The vertical jig is essentially a shaper table standing on edge. The fences do the same job as a regular shaper fence,

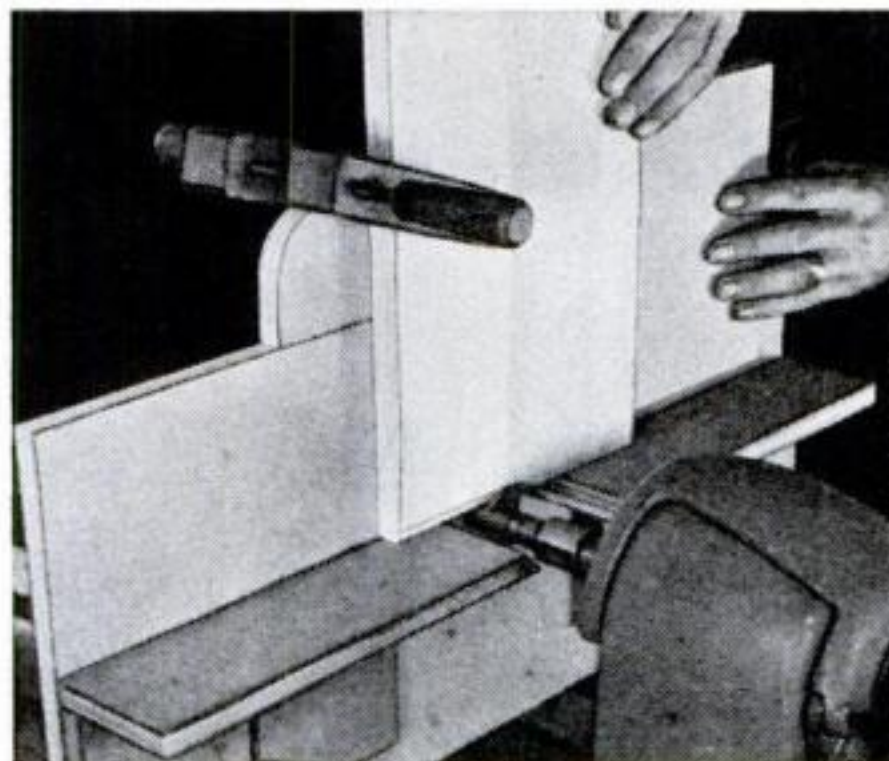
... and here's the vertical one in action



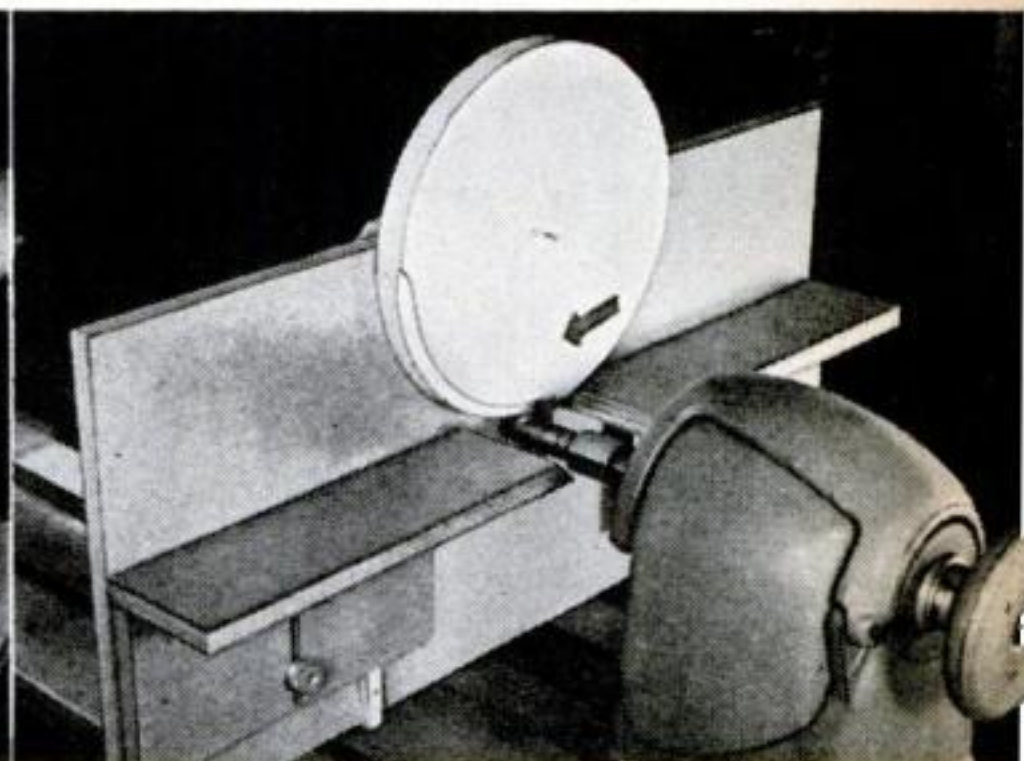
POSITION OF WORK is the big difference. For partial cuts (as here), fences are on the same plane. When the entire edge of stock is to be removed, raise the outfeed to compensate.



BY MOVING JIG toward the headstock you can use back edge of the cutter, getting more from a single shape. Provide depth-of-cut adjustment by lateral movement of jig on the ways.



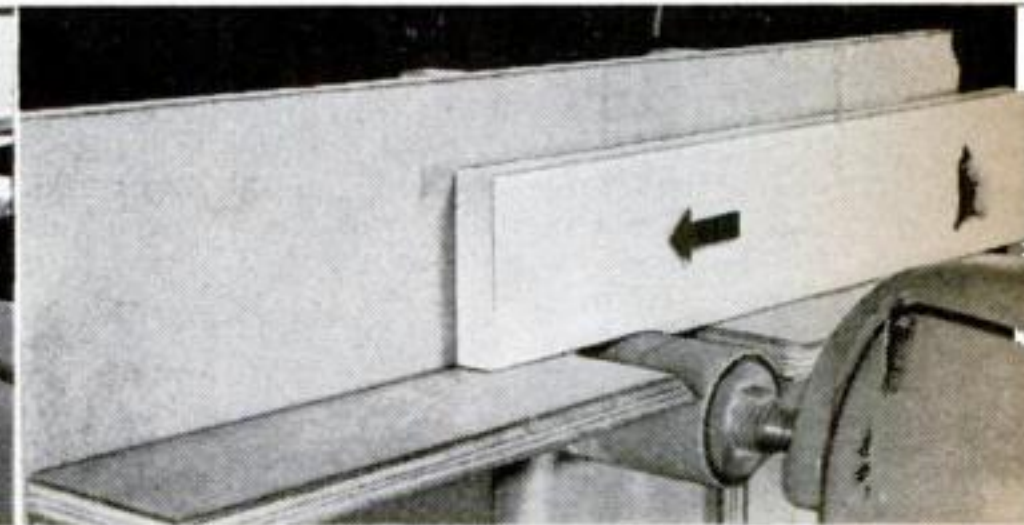
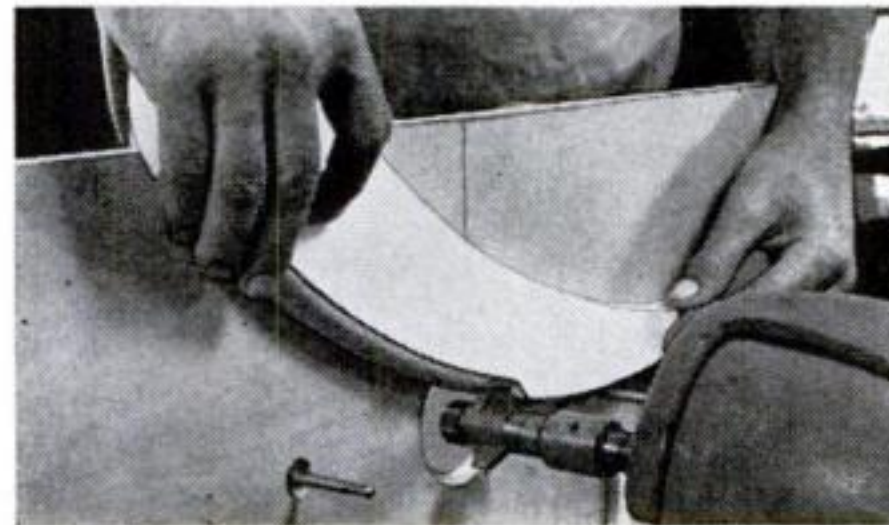
CLAMPING WORK to L-shaped guide makes cross-grain cuts safer and easier. Guide's long leg rides table edge; short one (at 90 degrees to first one) supports the work vertically.



CIRCULAR EDGES are shaped by pivoting disk on nail driven into table. For large disks enlarge table by clamping board to it. Position work first and move jig in to engage cutter.

FOR FREEHAND SHAPING against collars, remove the fences, add fulcrum pins. You can do straight pieces, but the setup is used mostly for curved and circular pieces, as below.

FOR SMOOTHEST EDGES, use a drum sander-jointer. Cut r.p.m. to 2,500 or 3,000 for fine drums, less for coarse. In making the jig, be sure to cut hole just large enough for the drum.



but here they also support the work.

On long jobs you stand at the side of the table and feed the work across. When the work is short or so shaped that you need to lean over the front edge of the table, use your hands so they are never directly over the cutter. It's the same rule as for conventional shaping; the only difference is the work position.

The fulcrum pins in the vertical table make freehand shaping against collars a safer operation. Resting the work against the left-hand pin provides support until the piece is bearing adequately against the shaper collars. There are some limitations here because of the lathe bed and the fence slide bars, but not enough to restrict most common jobs. The slide bars can be made removable by attaching them with screws instead of glue.

The horizontal jig makes it easier to handle larger panels. Since it changes the position of the work in relation to the cutter, it also increases the variety of shapes you can get from a single cutter.

More important, perhaps, is that you can use a miter gauge to move work

across the cutter, facilitating some kinds of cross-grain edge cuts.

By working with router bits, you can use this table for special types of routing and for horizontal drilling.

Construction tips. Use sound plywood or, better yet, hardboard-surfaced plywood. The jigs shown were made and sized for an Atlas 12" lathe. Unless you're similarly equipped, check the dimensions in the drawings against your own tool. Be particularly careful with the sliding jig bases; a lot of rigidity can be lost here. If dimension changes are required, work from intersecting lines that represent the vertical and horizontal center lines of the lathe spindle.

Use maple or birch for parts that will wear—the fence slide bars, the miter-gauge bar, and so on. Sand all parts carefully and assemble with a good white glue and finishing nails. Coat with sealer, sand once more, and put on a second application of sealer. A second sanding or smoothing with fine steel wool followed by a heavy application of paste wax rubbed to a polish completes the job. ■ ■



My Most Embarrassing Shop Moment

By Alfred L. Gehri
Seabeck, Wash.

A weekend guest at our beach cottage kept kidding me about a crude-looking chicken-wire gate I had hastily put up. Finally, since I refused to do anything about it, he insisted on making a gate himself and sending it to me.

It was a beauty, all right—two downward-curving halves with a decorative cut-out in the center of each. Along with them was a

note saying they had been made deliberately oversize and that I was to trim them to be sure of getting a precise fit.

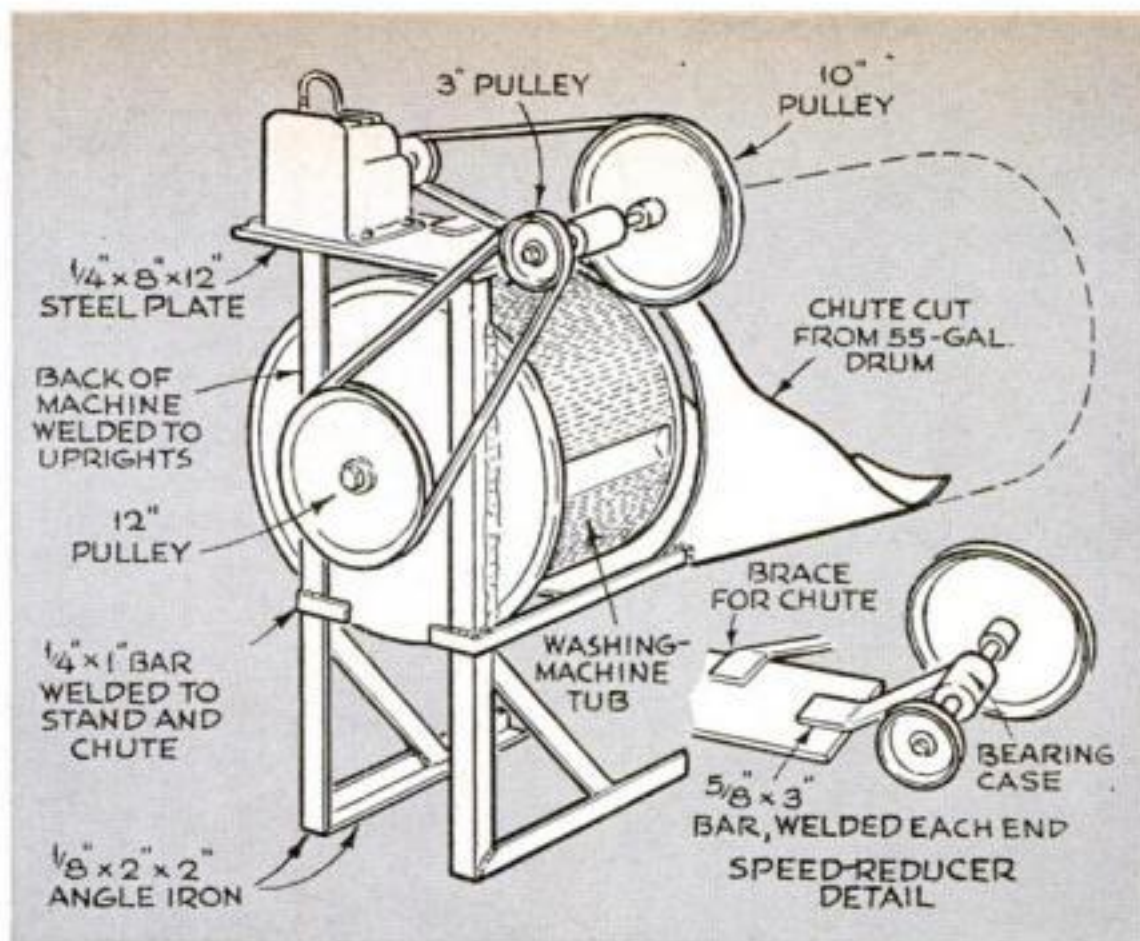
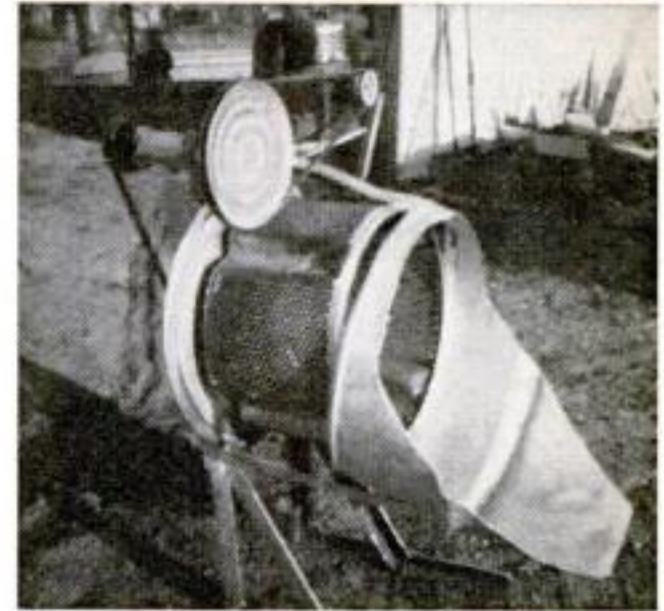
Good fishing and general procrastination, however, put off hanging the gate until we got a call from my friend saying he'd be down that afternoon for another visit. That did it. In a sweat to get the gate hung before he arrived, I quickly mounted the two halves and found they overlapped about 1½" at the center. I carefully marked the lap on both pieces and zipped them through the saw.

You can guess the rest. When the halves were rehung, there was 1½" of pure atmosphere between them. Instead of dividing the lap and taking half off each side, I had taken the whole lap off each.

My friend was about to arrive, and there was only one solution. I had to dig up one of the gate posts and move it over to make up the gap. When I proudly showed my friend the job, he just smiled and said: "Well, the gate looks fine, but you sure ought to fix that cockeyed post."

Short Cuts and Tips

FROM PS READERS



Motorized Sand Sifter from Scrap Parts

A TUMBLER tub salvaged from an old Bendix washer, pulleys and a bearing from a junked tilling tractor, \$5 for other materials—plus two hours' work—added up to an efficient power sifter ready to be belted to any small motor. I've used

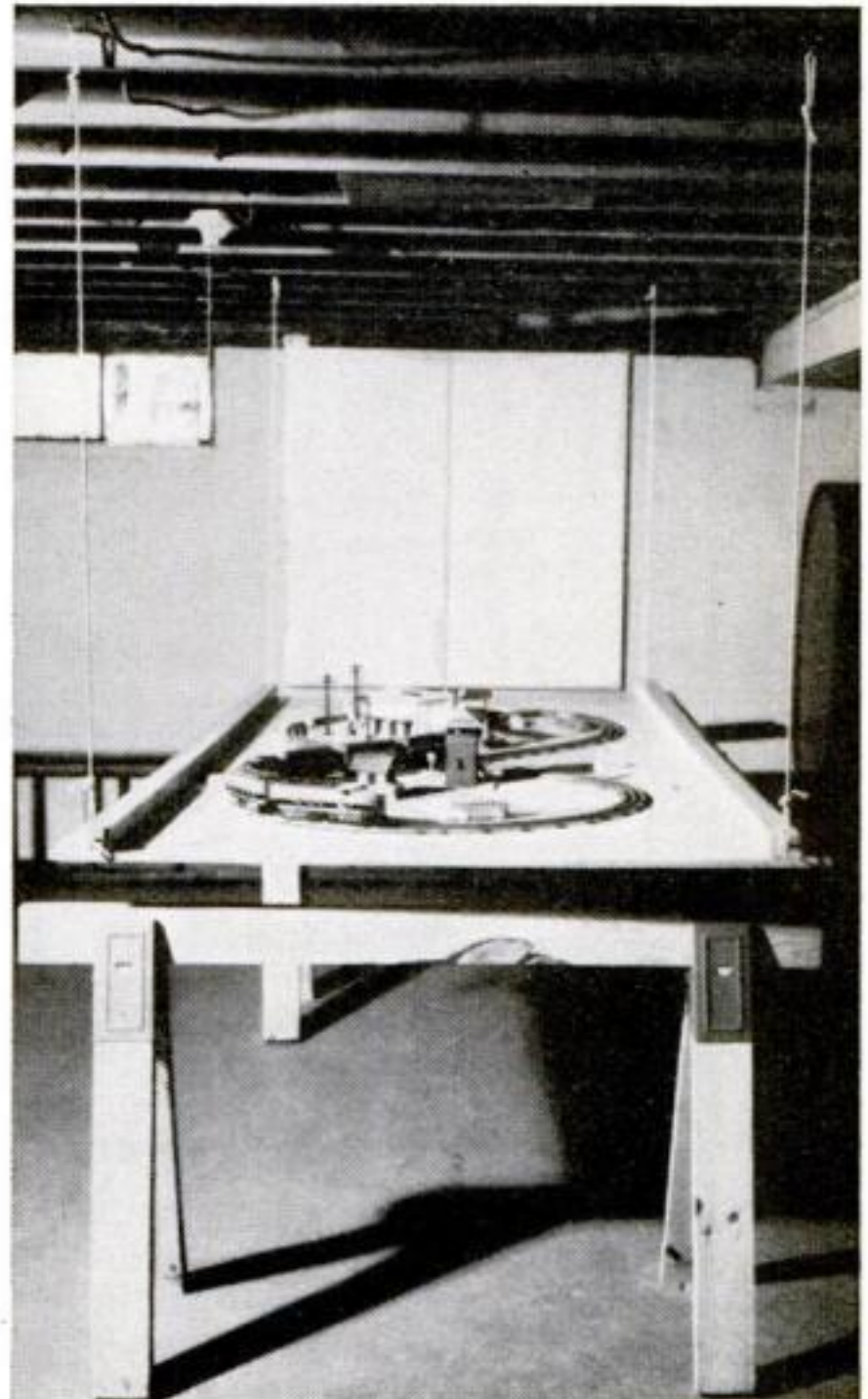
it to sift stones from top soil and mortar sand. Stones and pebbles roll out of the revolving tub and down the chute, while fine particles drop through the perforations, into a neat pile ready for use.—*H. D. Burgess, Battle Creek, Mich.*

Suspending a Train Table

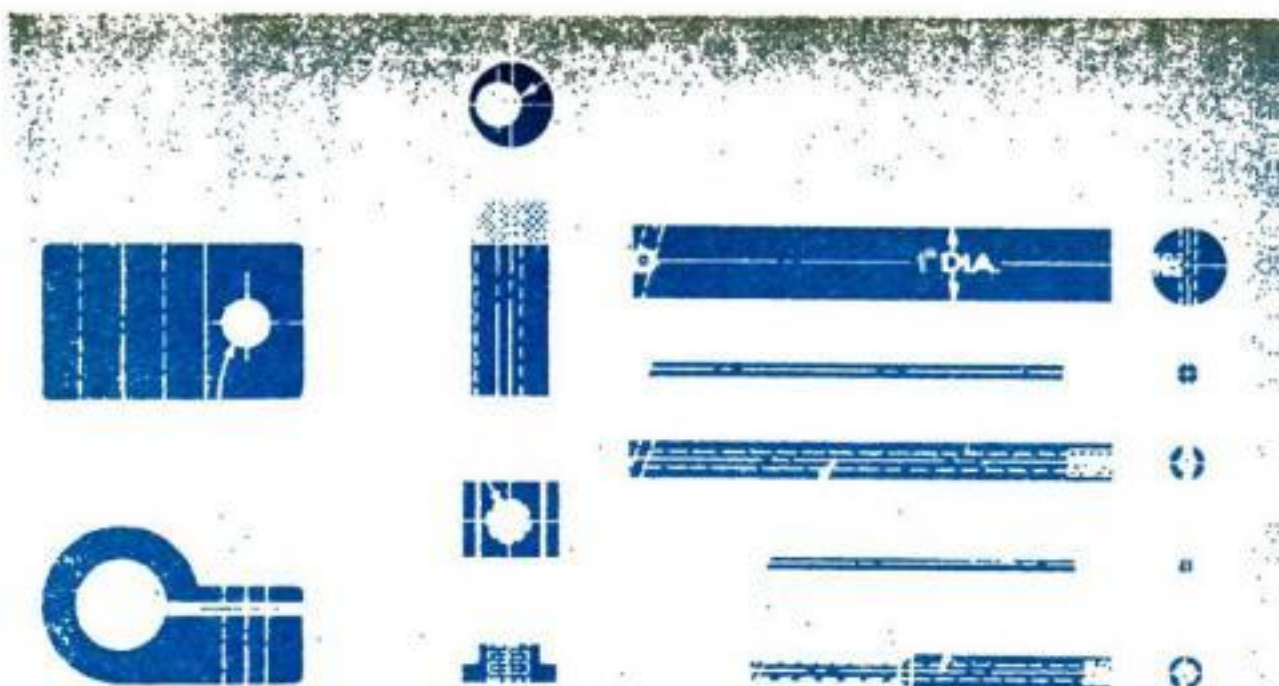
EVER since he got an electric train for Christmas, my son has monopolized my sawhorses to support his track board in the basement. I don't like to dump his railroad each time I need my horses, so I devised this system.

Twist a screwhook into each corner of the track board, aligned with screwhooks driven into the joists overhead. Tie loops in both ends of four pieces of clothesline, leaving them long enough to suspend the table so you can slip the horses out. When you replace the horses detach the loops from the table hooks and criss-cross the cords between the ceiling hooks.—*Gordon Nelson, Gladstone, Mich.*

▶▶▶ I WANTED to pour rust inhibitor into my car radiator but found it filled to the brim. Getting at the drain cock is a dirty, awkward job, so I siphoned out some of the water, instead: I turned on the garden hose for a light stream and inserted the nozzle into the radiator as far as it would go. Then I disconnected the hose at the tap. It acted as a self-starting siphon. Just be sure to flush the hose with clean water afterward.—*Charles W. Adams, Arvida, Que.*



One MACHINIST tells another...



...Modern Outfit Banishes

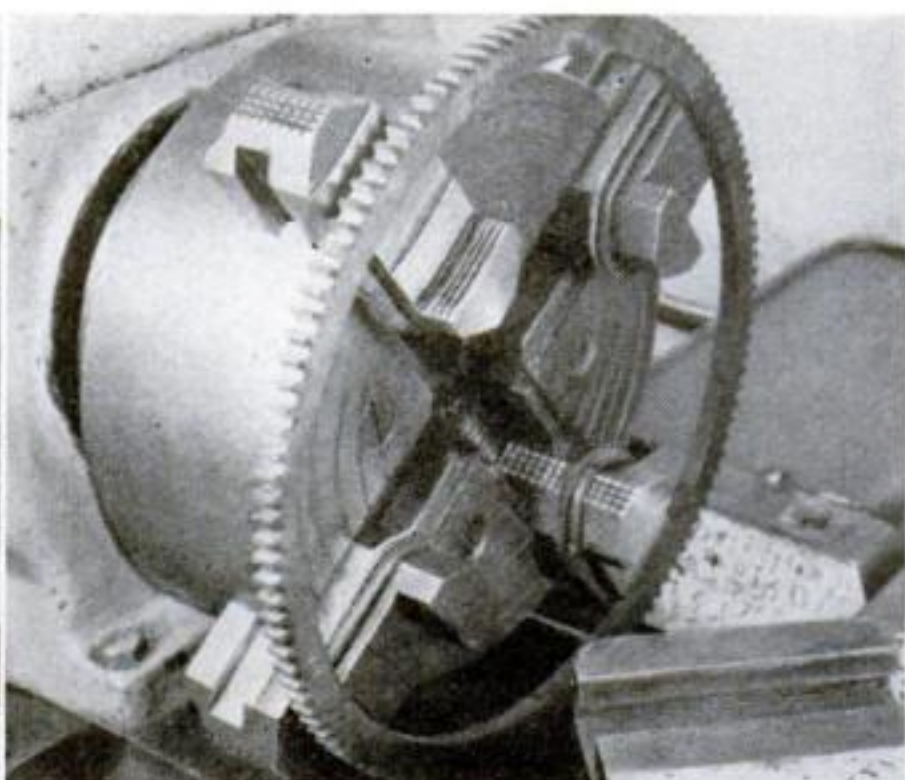
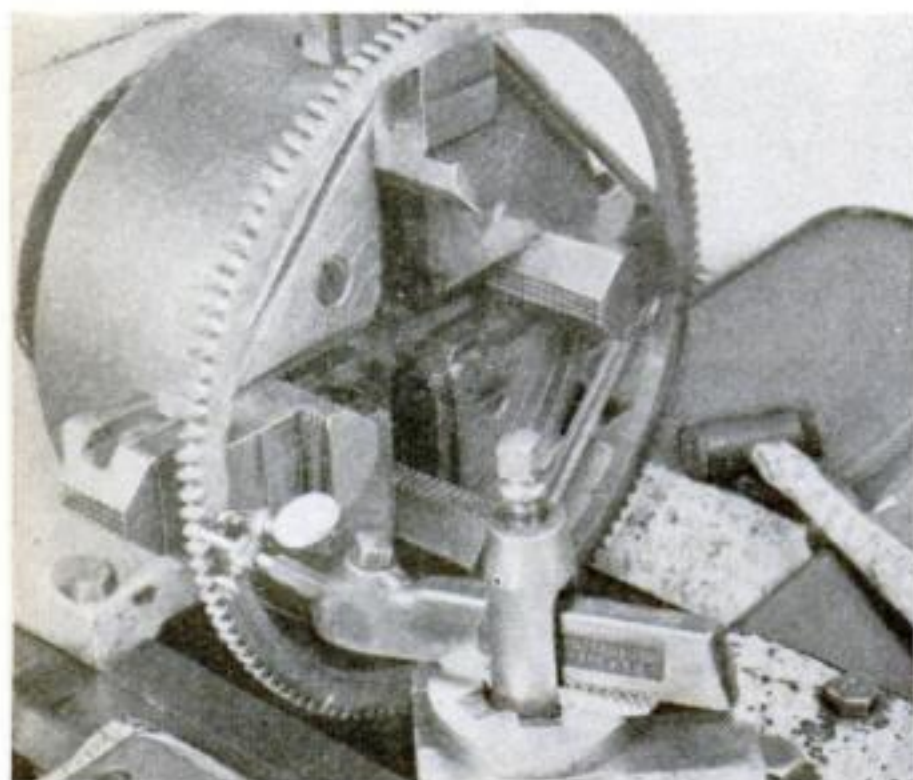
THIS rig you can make yourself will take the fuss and fumble out of boring jobs on your lathe. A single bolt fastens the holder and locks the boring bar. It takes bars from $\frac{1}{4}$ " in diameter to 1". The smaller bars have a through-body clamping feature—fine for tight quarters.

If the outside shape of the holder presents a problem, due to your limited machining facilities, leave it square as shown by dotted lines in the drawing.

Drill and ream the 1" hole in the

body on the lathe to insure accurate location. To do this, first drill the $\frac{1}{2}$ " bolt hole and make the T-slot nut. Mount the holder body on the compound with a $\frac{1}{2}$ "-by-2" hex-head cap screw and washer. Square it up and drill and ream by chucking the tools and feeding into them with the carriage.

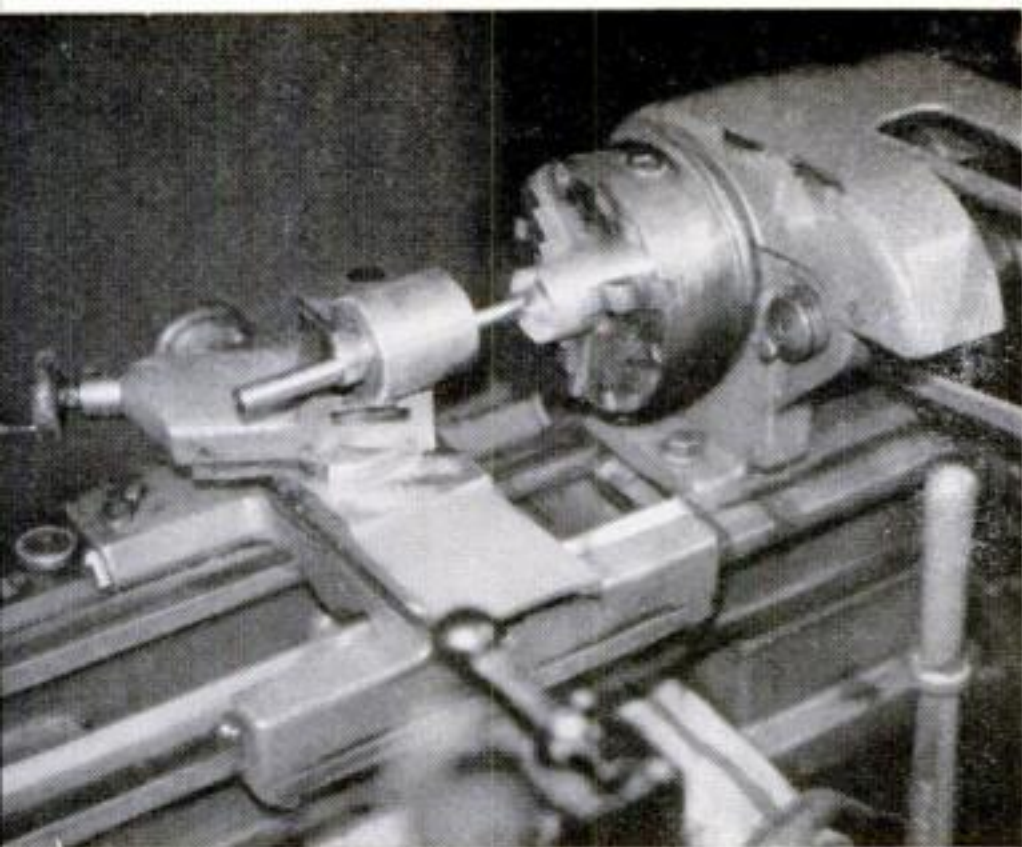
Drill the eccentric bushing on the lathe by chucking the blank in an independent-jaw chuck. If you have only a universal chuck you can still do the job



"O" Rings Make Handy Spacers

WHEN you have to face a narrow part, such as this large ring gear, try rubber or neoprene "O" rings as self-retaining spacers. You can use them in either of two ways: Large rings can be stretched

over all four jaws or small rings may be slipped over individual jaws. The rings have enough give to allow easy squaring up to the face of the work, but are firm enough to back up the work against moderate pressure from the cutting tool.—H. J. Gerber, Stillwater, Okla.



Boring Woes

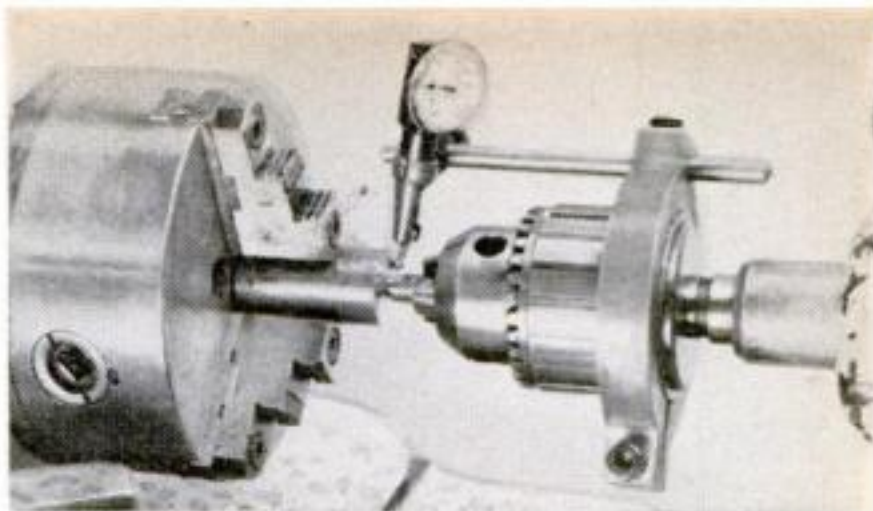
by opening it until the #3 jaw comes off the scroll. Close the jaws, skipping the #3 jaw until the next revolution of the scroll. This will throw the chuck enough off center to hold the workpiece for drilling the eccentric. Since the off-center hole is only to provide adjustment, extreme accuracy isn't needed.

The $\frac{1}{4}$ " bar uses $\frac{1}{8}$ "-diameter tool bits, which can be made of hardened drill rod. The other bars use standard square bits.—*R. O. Konopka, Cleveland.*

Clamp Makes Centering Jig



You can cross-drill a true lead hole in round stock with this jig. The nut tightens down against the workpiece to clamp it. Bend up a clamp of flat steel to fit the grooves in your V block as shown in photo. Drill and tap the top part so the hole is accurately centered over the V. Add a center-drilled cap screw and hex nut to complete the jig. For small stock, move clamp to next groove.—*G. F. Hengel, Wayne, N. J.*



Gauge Drilling Depth Precisely

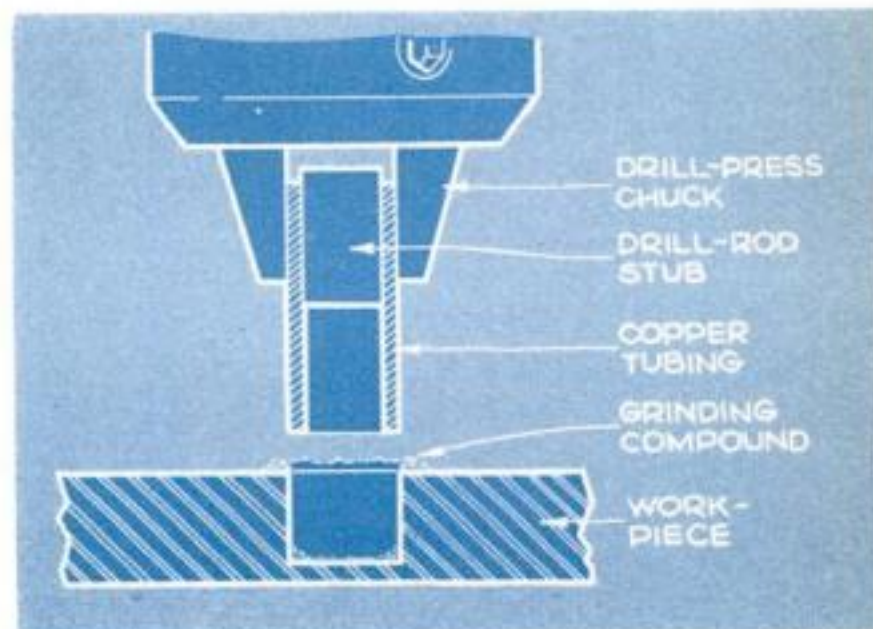
A DIAL indicator, mounted as shown, makes an excellent depth gauge when extreme precision is needed.

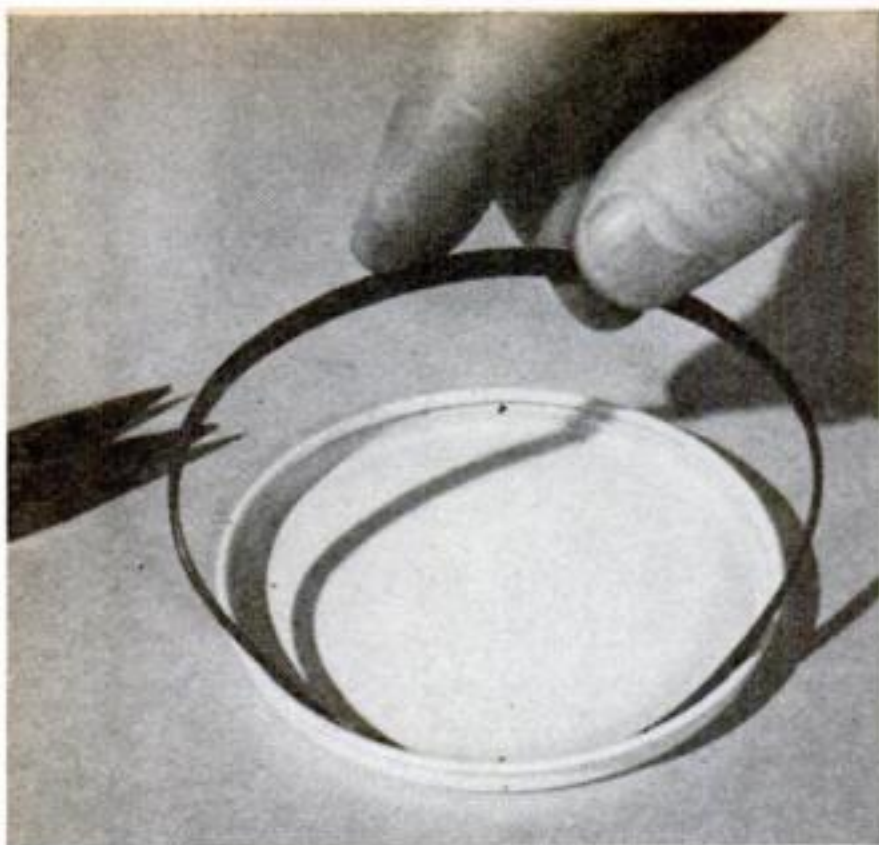
Make a split-collar clamp to attach the indicator to the drill chuck. An adjustable extension rod supports the indicator at the desired position, as in photo above. Set the indicator correctly on the first piece drilled and each subsequent piece will then be drilled to exactly the same depth—if the feed is stopped when the indicator needle comes to this same position.—*H. J. Gerber, Stillwater, Okla.*

How to Drill Hardened Steel

You can drill holes in hardened steel by the same method used for drilling glass: Chuck a short length of copper tubing in the drill-press chuck. The outside diameter of the tubing should be the desired diameter of the hole. It's a good idea to drive a snug-fitting piece of drill rod into the top of the tubing to keep the chuck from collapsing it.

The drilling is done by abrasion. You use valve-grinding compound or abrasive grit mixed with light machine oil between the rotating tubing and the workpiece. Lift the "drill" frequently to add abrasive and don't apply excessive pressure.—*F. Strasser, Santiago, Chile.*





Drive Belt from Jar Lid

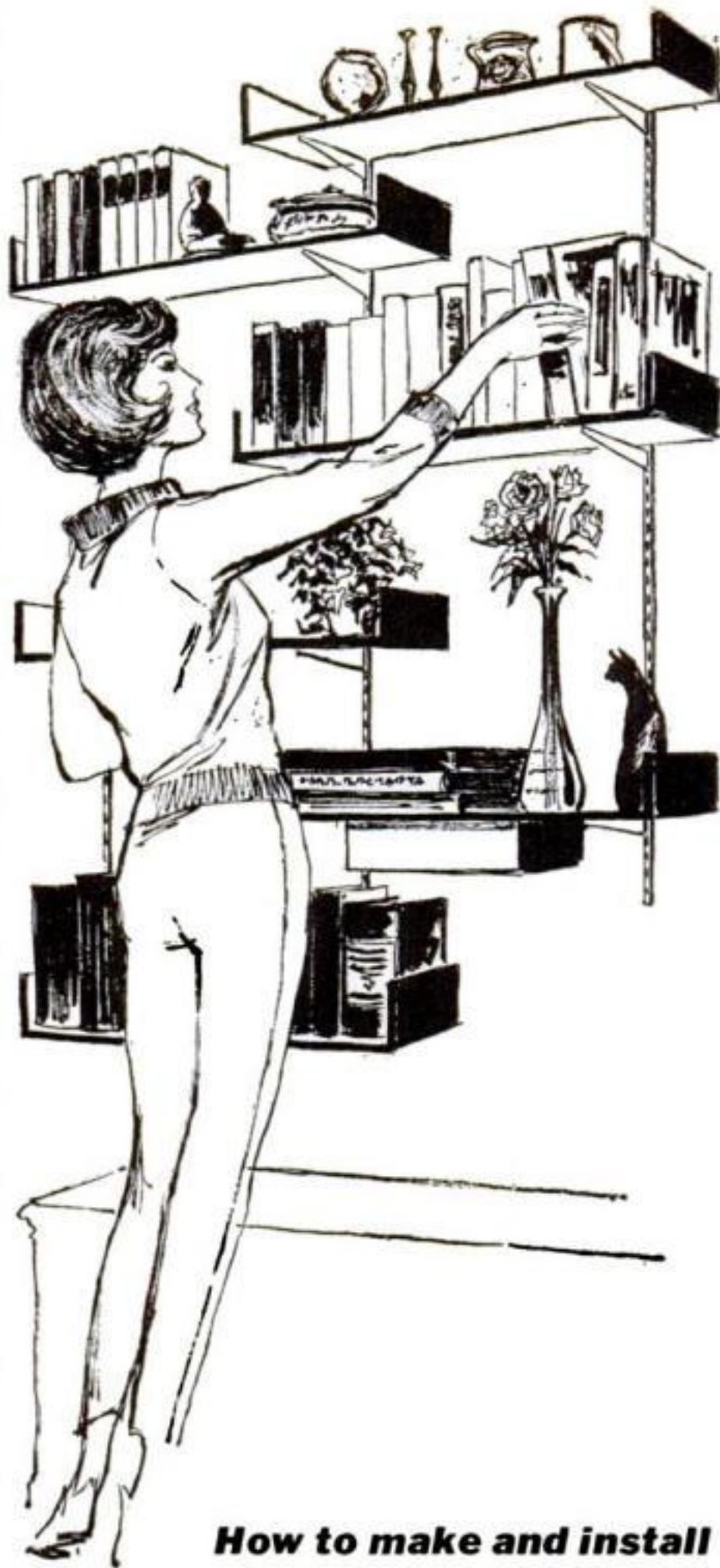
WHEN you need a drive belt for a powered toy or mechanical model, try using the rubber sealing ring from a pry-off jar lid. This type of lid is often found on sandwich spreads and jams. Detach the ring gently with a screwdriver. It makes a good flat belt that won't slip in use.—*Ken Murray, Colon, Mich.*

▶▶▶ APPLYING wallpaper remover? Throw away the sponge. A more efficient way to saturate the old paper is to dip a paint roller in the solution, squeeze slightly to prevent dripping, and roll it over about 20 or 30 square feet at a time.—*Allan F. Walker, Northridge, Calif.*



Lay Out Big Projects on Floor

CAN'T find a sheet of paper big enough for a full-scale drawing? Chalk the layout on a clean-swept basement or garage floor—as I did to find the angles for half-lapping the legs of a sawbuck table.—*Jackson Hand, Westport, Conn.*

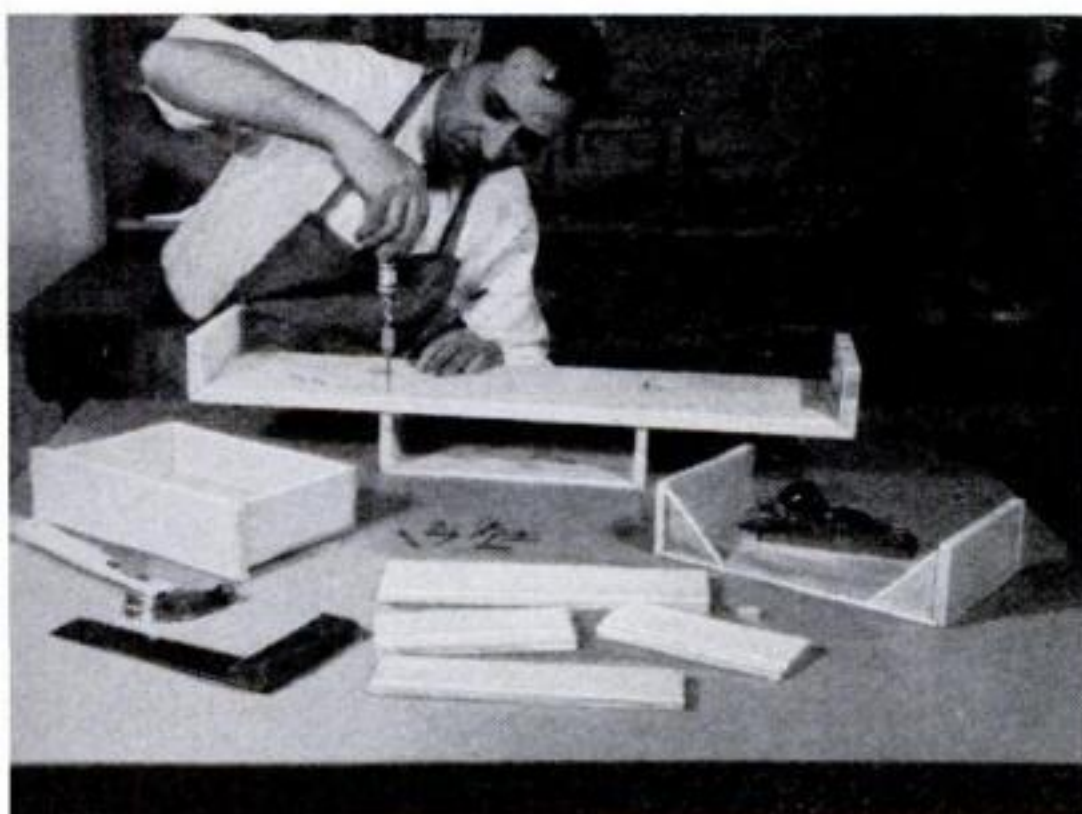
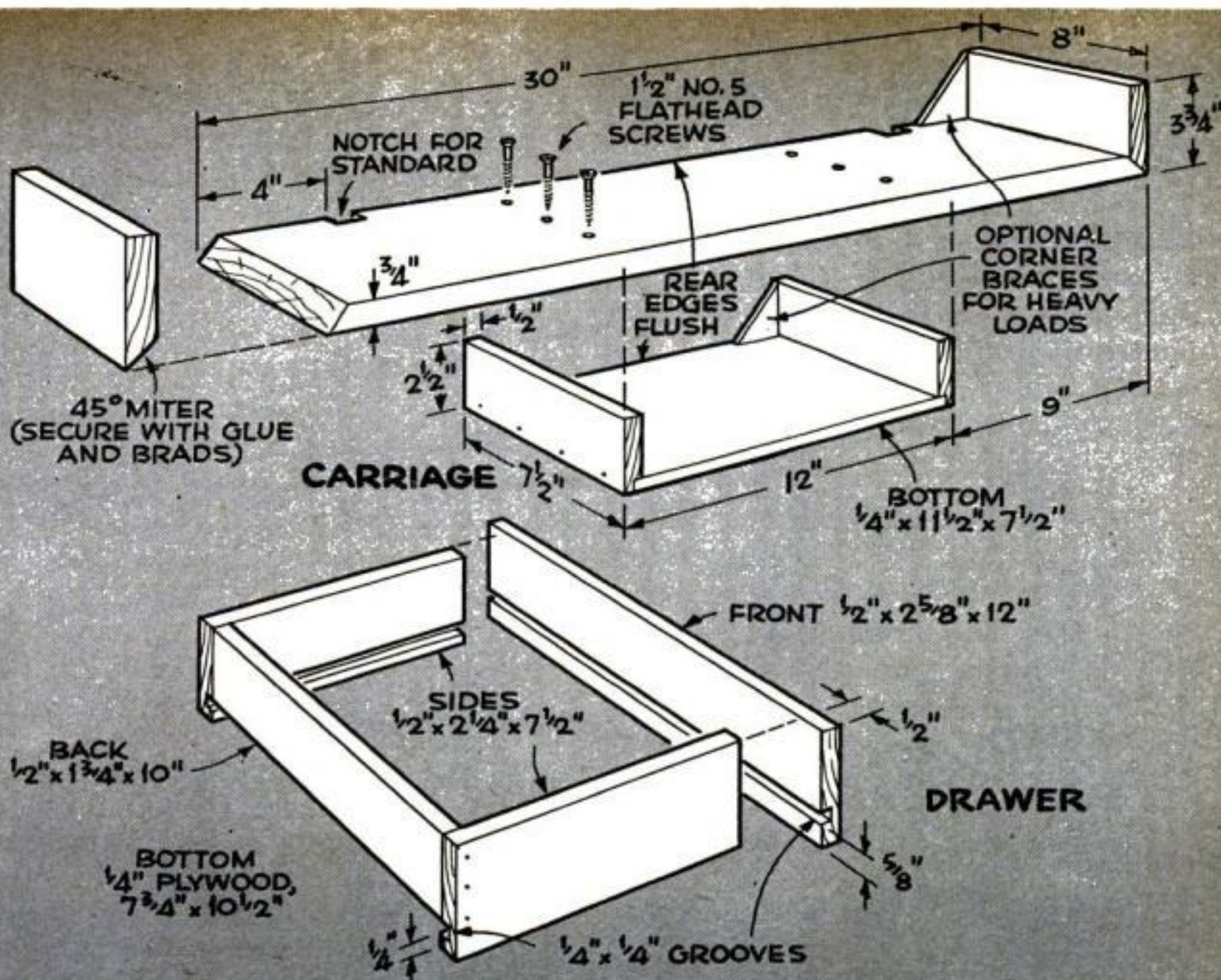


How to make and install

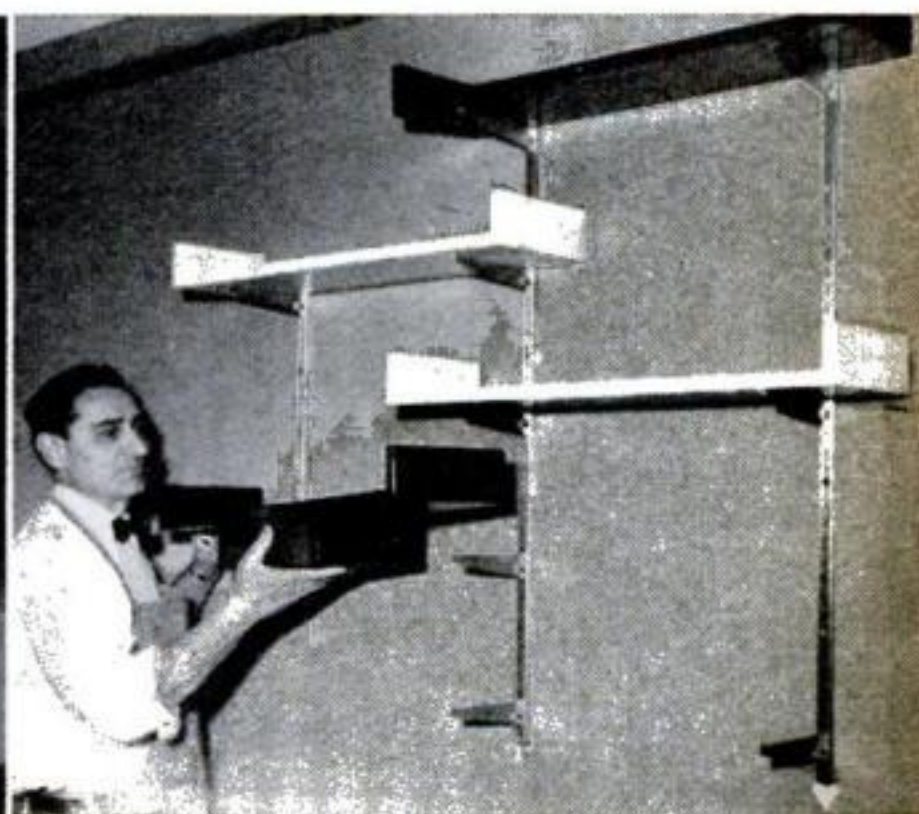
Staggered Book Shelves

THESE random shelves are as functional as they are handsome, and are lighter and more flexible than bookcases. The shelves are cantilevered from the wall on brackets hooked into metal wall standards.

One disadvantage of open book shelves:



SHELVES WITH DRAWER require two extra assemblies. Glue and brad carriage parts together (right) before attaching to shelf. Drawer parts are shown at center, assembled drawer at left.



LOCATE STANDARDS CAREFULLY, so shelves set level. This arrangement calls for one 24" and two 48" standards. Shelves, too, could be of varying lengths, crossing several standards.

Each needs a set of bookends. Not here. The ends fold up with simple miter joints. An underslung drawer (for keys, pencils, stamps) can be added to any shelf below eye level. The front extends below the carriage for a finger grip.

In many commercial units, the shelves

are set in front of the standards; this leaves a gap at the wall and lets the shelves shift out of alignment. Notches in my shelves bring the rear edges flush with the wall and lock them in position. They're made of pine, enameled black and white.—*Alvaro A. Altomare, NYC.*

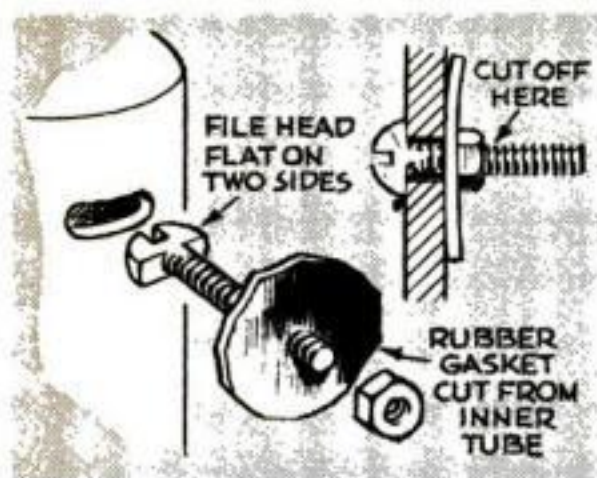
Short Cuts and Tips

FROM PS READERS

Two-Way Trailer Protects Its Load

FOLKS rub their eyes at this unique trailer—it seems to be going two ways at once. It was made by welding together the trunk sections of two 1950 cars and mounting them on a steel axle and frame. The lids provide a hatch at each end and protect the load from wind and weather. The bumper is left on the back

only. The hitch is out of the picture, to the left.—*Grover Brinkman, Okawville, Ill.*



Plugging Leaks in a Water Tank

A YEAR ago my 30-gallon hot-water tank sprang a leak. I drained the tank and drilled a $\frac{3}{16}$ " hole through the side, centered on the pinhole leak. I elongated this hole to each side with a small round file, until it would pass the flattened head of a 10-32 brass screw. Inserting the head, I gave it a quarter turn to seat it against the inside of the tank and turned the nut up tight against a rubber gasket on the outside.—*H. C. McClellan, Willow Grove, Pa.*

Snug Mounting for Air Conditioner

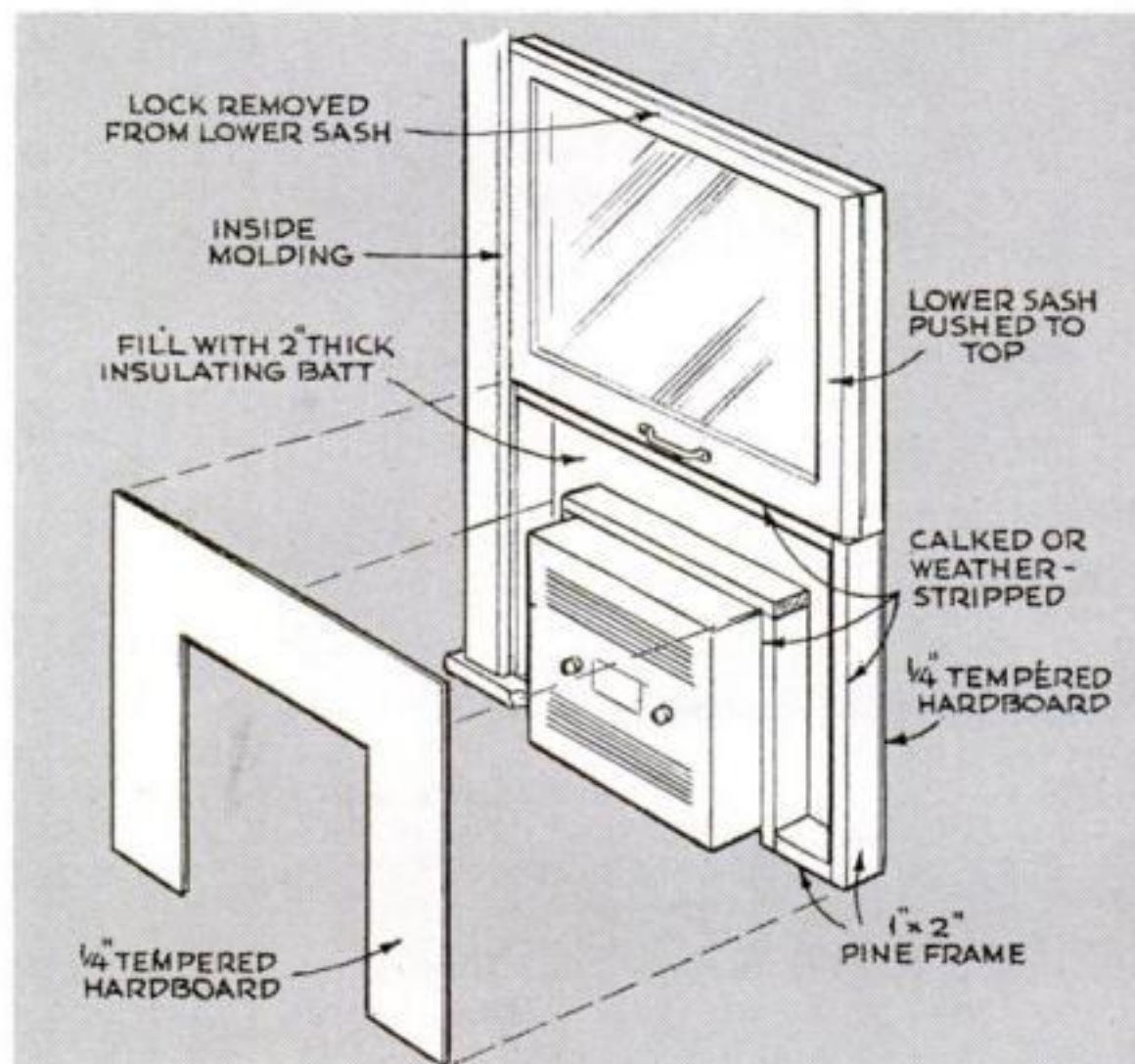
WHEN an air conditioner is left in place all year, a tight installation is necessary to keep out cold drafts.

An insulated panel fitted tightly around the unit and then calked or weather-stripped will seal out winter's worst and keep interior warmth from escaping.

Remove the lock on top of the lower sash and push the sash all the way to the top of the window, inside the upper sash. Combined in this way, the double glazing eliminates the need for a storm window.

Fill the space inside the insert panel with fiber-glass batts and assemble it.

To install the panel, you'll have to remove the sash parting strip and loosen the inside molding. After fitting the panel



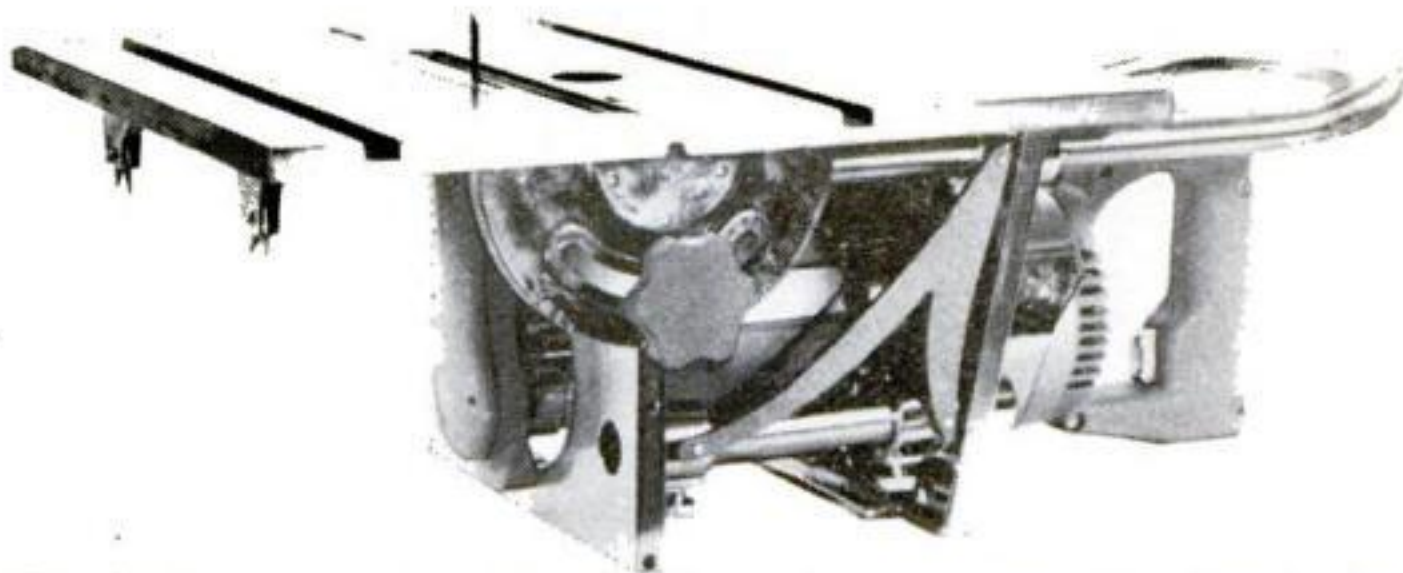
into the window opening, nail the molding back on and calk all the joints.—*C. G. Dunham, New Brunswick, N. J.*

HOME SHOP

news report

By Sheldon M. Gallager

New: a multipurpose tool that's portable, too. Now they've turned what looks like an ordinary $\frac{1}{2}$ " drill into a whole shop. An ingenious table and stand do the trick. Depending on how you set them up, they change magically into a 7" table saw, drill press, shaper, sander, jigsaw, saber saw—you name it, the works.



The basic power unit is a husky $\frac{1}{2}$ -horse motor, but here's the real surprise: You can run it on either house current or (with an adaptor) on 12 or 24 volts. You can tote it off to a summer cabin and power it from your car battery, even use it aboard a boat. Packed up, it weighs only 36 pounds and measures 14" by 20". Called the Porta-Shop, it will sell for about \$300 from Porta-Shop Precision Tool Corp., 1717 N. Long Beach Blvd., Compton, Calif. Though not yet available for a test report, it looks from here like a real nifty.

All about welding—for free. Looking for good tips on arc-welding? You'll find plenty in a fine little 84-page pocket guide available just for the asking from Hobart Brothers Co., Troy, Ohio. They're the people who make welders and also run a welding school—they should know. . . . The tricky art of welding aluminum is simplified in another handy aid. This is a dial-type selector card that tells you at a glance the proper heat, speed, preparation, and other factors for any type of joint and stock thickness. It's free if you write for it on a business letterhead to Olin Metals Div., 400 Park Ave., NYC.

Why a radial-arm saw rather than a table saw? You may have wondered. What does a radial-arm offer you, anyway? Now hear this: "The radial-arm saw combines the solid precision of a stationary table saw and the flexibility of the portable electric cutoff saw."

It seems to us this sums up the case for the radial-arm rather aptly. The speaker is R. J. De Cristoforo. He makes the statement in an opening chapter of a new book (his eighth), "Fun with a Saw," published this winter by McGraw-Hill at \$5.95. Cris is a regular contributor to Popular Science. (For his latest piece, see "Jigs Make Lathe a Shaper" on page 160.) About the radial saw, he says further:

"When you place a board on the table and pull the blade through for the cut, you know it will be square and true. This is probably the very first thing you'll do on a radial-arm saw. If you've never worked with a power tool before but have experienced making a similar cut with a handsaw, even this simple procedure will awe and amaze you. This is the strength of a power tool—providing accuracy automatically, letting you be the creative master, so to speak, while relieving you of much effort."

Smart ideas: We won't have to worry about nails popping out any more, says the maker of a new fastener that embeds itself in wood like a fishhook. One half of a split shank curls outward as it's driven, forming a barb so strong the nail is said to be unremovable. (Better not try it on anything temporary.) The maker: Waldrop Enterprises, 805 W. Bowie St., Arlington, Tex.

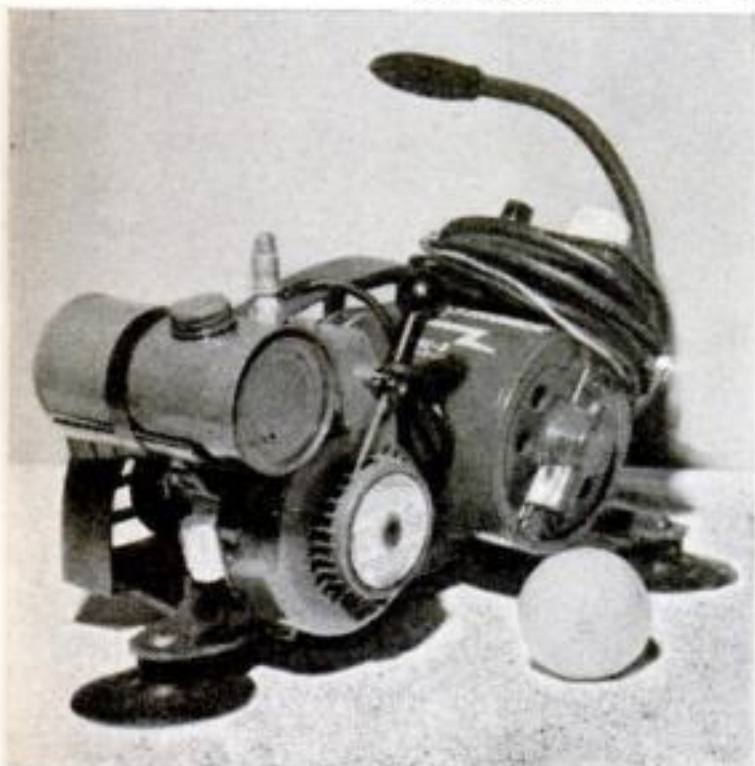
That nonsense of having to find special saber blades to fit your particular make of saw is at last on the way out. Thanks to Parker Mfg. Co., Worcester, Mass., a new selection of famous Trojan blades is designed to fit nearly all makes of saber saws on the market. Five types handle thick or thin wood, plywood, metal, tile, leather, and other materials.

Pittsburgh Corning Corp., Pittsburgh 22, says "let there be light for fallout shelters." You can now add windows made of solid-glass bricks that offer as much radiation protection as an equal thickness of concrete. The bricks come in several sizes, are load-bearing for structural walls, and have been approved by the Office of Civil Defense.

Want a portable foldup bar for barbecues or the rumpus room? Plans for making your own are free from National Plastics Products, Odenton, Md., makers of Nevamar counter toppings.

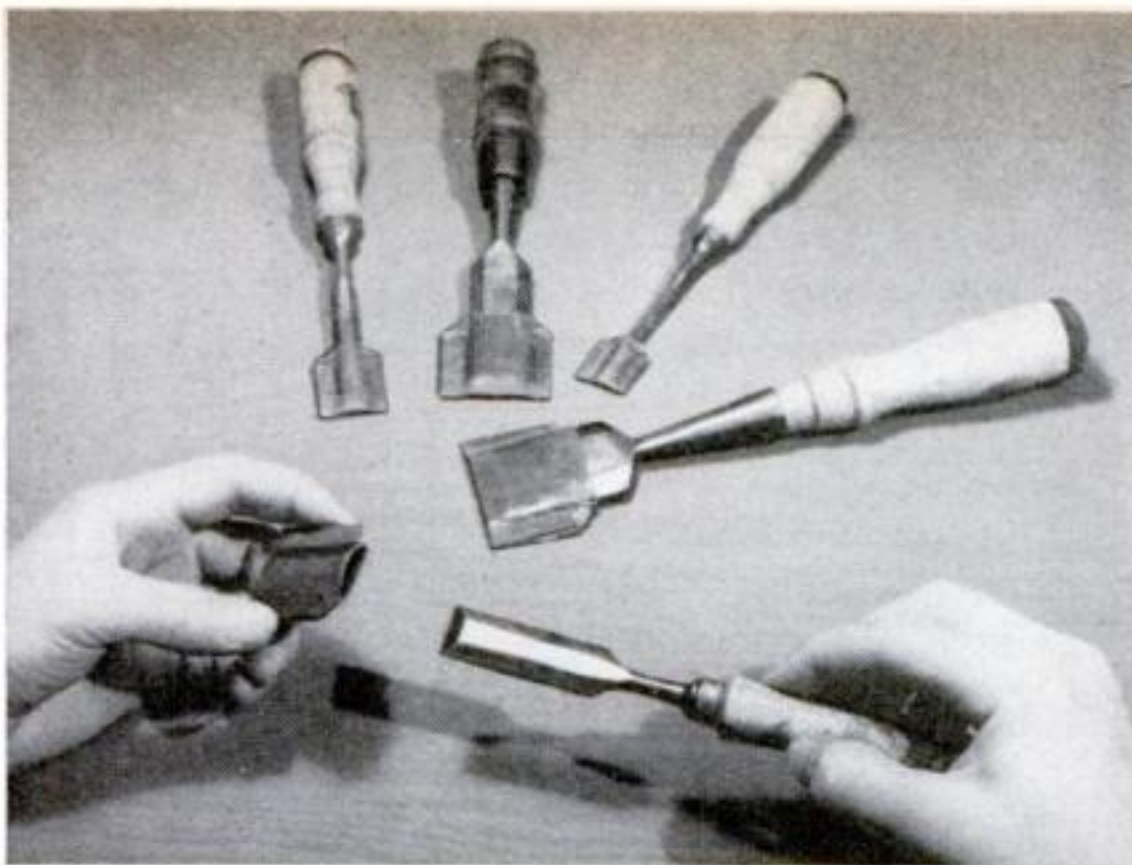
Good news for often fretful mixers of epoxy paint: A new type now comes in an ingenious twin-spout container. As you pour, you automatically blend equal quantities of both ingredients to get an accurate mix every time. Called Poly-Aqua, the epoxy paint is made by D. J. Peterson Co., Box 181, Sheboygan, Wis.

Tiny two-in-one generator is a battery charger, too. That versatile little $\frac{3}{4}$ -hp. Ohlsson & Rice gas engine that does so many wonderful jobs ["Home Shop News Report," Jan., p. 192] is at it again. Now it runs a small portable generator for use around the home, aboard a boat, or off in the wilds.



The remarkable part: Two settings give you a choice of 110 volts AC for household appliances or 10 amps DC for charging 6- or 12-volt batteries. On AC, you get 200 watts (up to 300 on surge)—enough to operate small power tools as well as lights. (We tried a $\frac{3}{8}$ " drill and it worked fine.) So you're ready for anything—a power failure or a dead car battery.

The complete rig, shown at left alongside an orange, stands less than a foot high and weighs only 23 pounds. An upward-sweeping handle balances it nicely for easy carrying. Called the KGC-3, it will sell for about \$150 from Kres-tronics, 140 Sheldon St., El Segundo, Calif.



Short Cuts and Tips

FROM PS READERS

Lead Sheaths for Your Wood Chisel

TO PROTECT the keen edge of a wood chisel, sheathe the blade with sheet lead. Snip a rectangle twice the desired sheath length, fold in half, hammer-tap to fit blade, and bend doubled corners.—*R. Gilmore, Sonoma, Calif.*

Easy-to-Read House Number

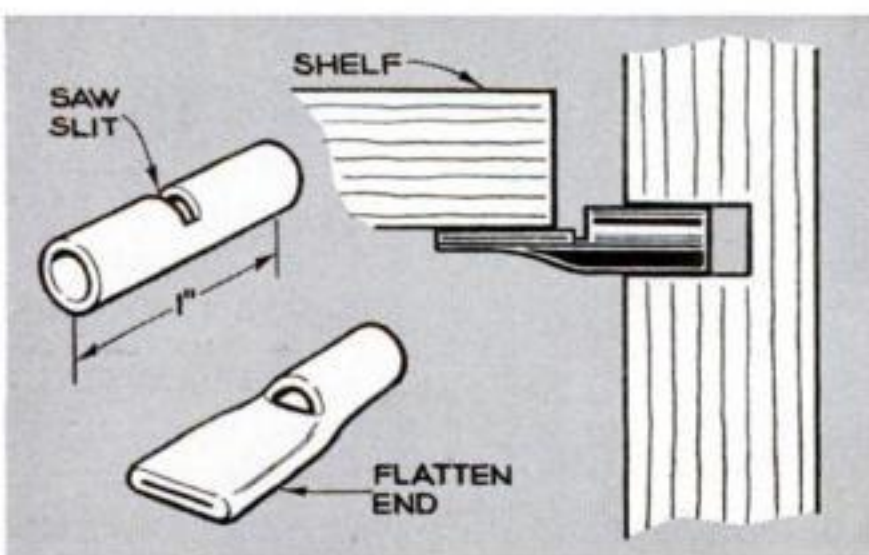


ATTACHING your house number to a piece of $\frac{3}{16}$ " or $\frac{1}{4}$ " clear plastic and mounting it away from the wall gives it good night-time visibility. Light from a porch lamp or windows makes numerals stand out sharply.—*Edward Kearney, San Jose, Calif.*



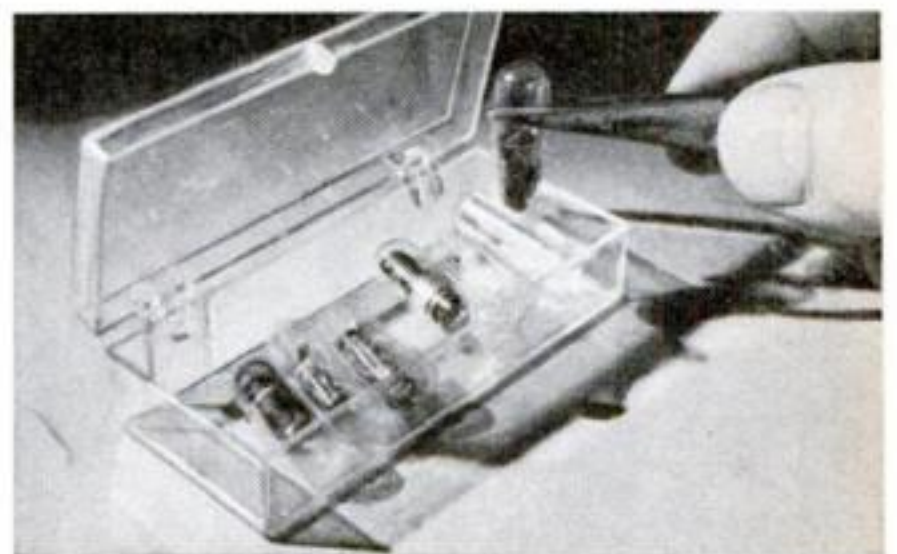
Skate Sharpener Smooths Glass

SHARP edges of newly cut glass can be rubbed down with a small plastic ice-skate sharpener. Rest the aluminum-oxide stone on the glass as shown in the photo. The sharpener may be used wet.—*Robert Burgett, Hamilton, Ohio.*



Adjustable-Shelf Supports

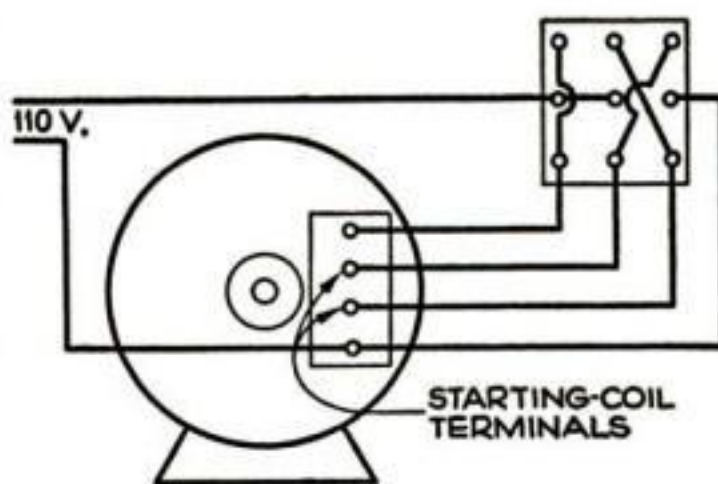
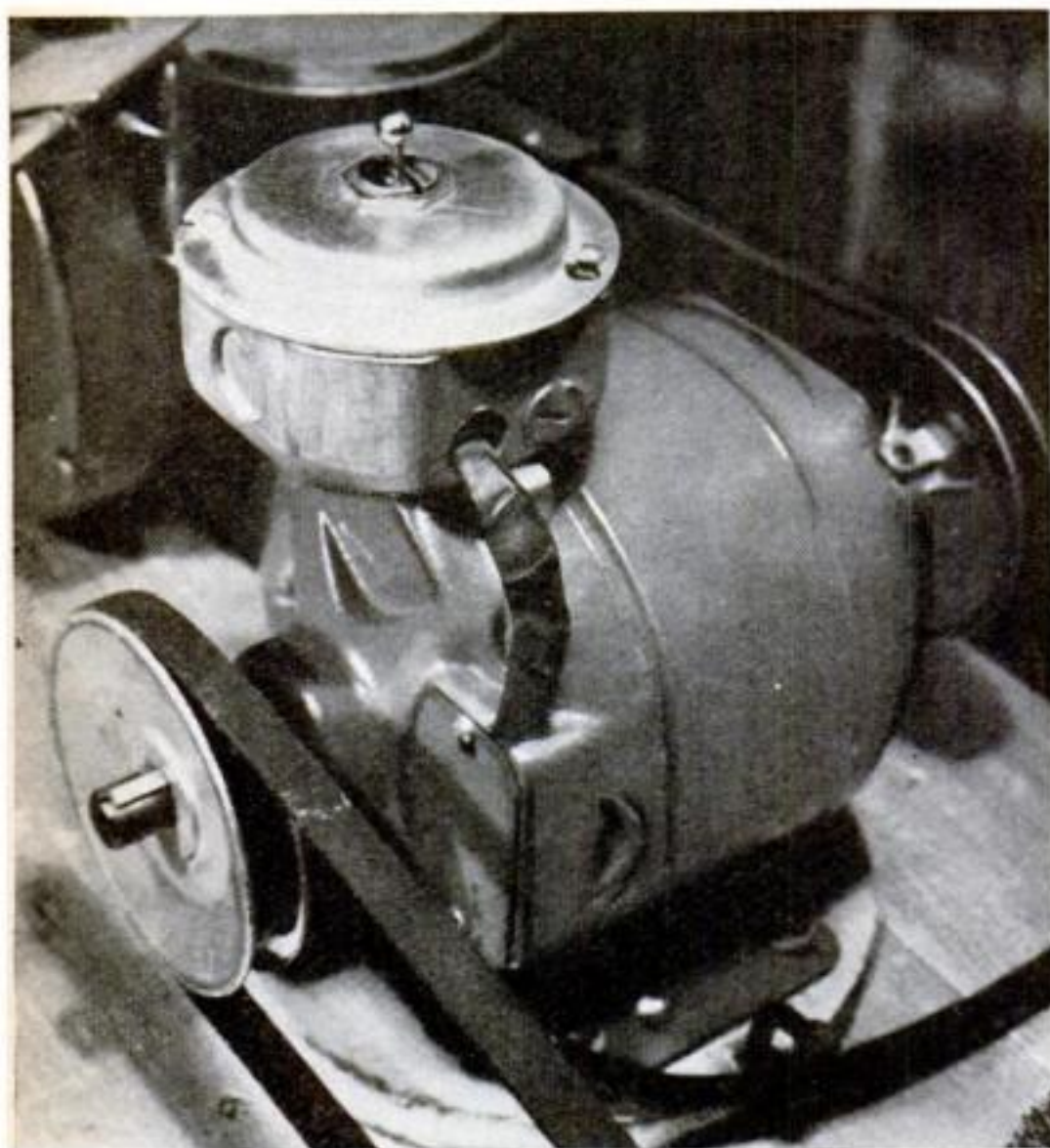
SUPPORTING pegs for shelves can be made from any metal tubing that fits the peg holes. Mark off 1" sections of tubing, hacksaw a slit about a third of the way through in the center of each length, and saw the lengths apart. With heavy pliers, flatten the tubes at one end.—*Harry Walton, White Plains, N. Y.*



Capsules Hold Small Parts

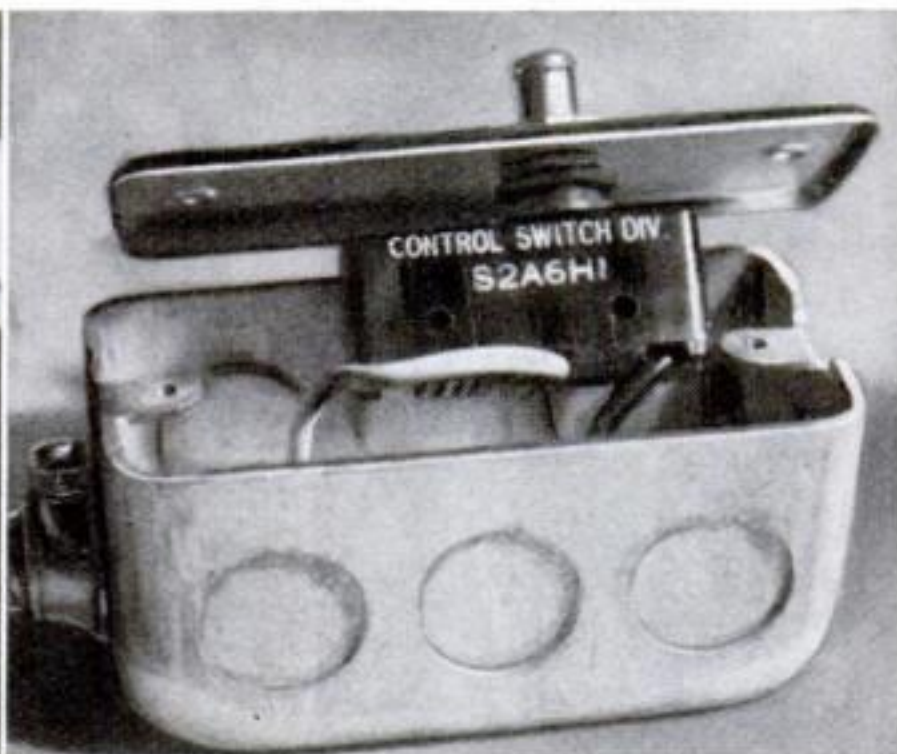
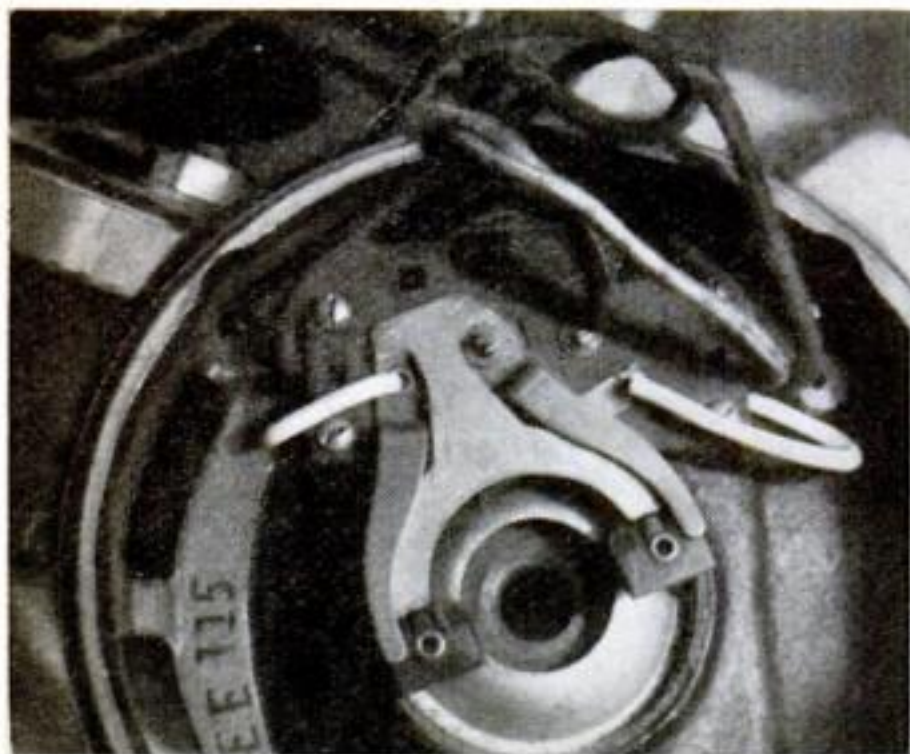
MINIATURE screws and rivets, contact points, and other tiny parts are best stored in No. 00 gelatine capsules. These, in turn, are kept in a transparent-plastic box that fits your pocket. Capsules protect the delicate parts from moisture and dust, and contents are seen at a glance.—*Ken Murray, Colon, Mich.*

Two Reverse Switches for Electric Motors



1 A single-switch control. Most reversible motors have separate switches for on-off and reverse. You can combine these into one triple-pole, double-throw, center-off switch, available from large electronic-supply houses. Get one with enough capacity to carry the starting surge.

Wire it as shown above and mount it in a standard 4" junction box atop the motor (left).—*Robert Burgett, Hamilton, Ohio.*



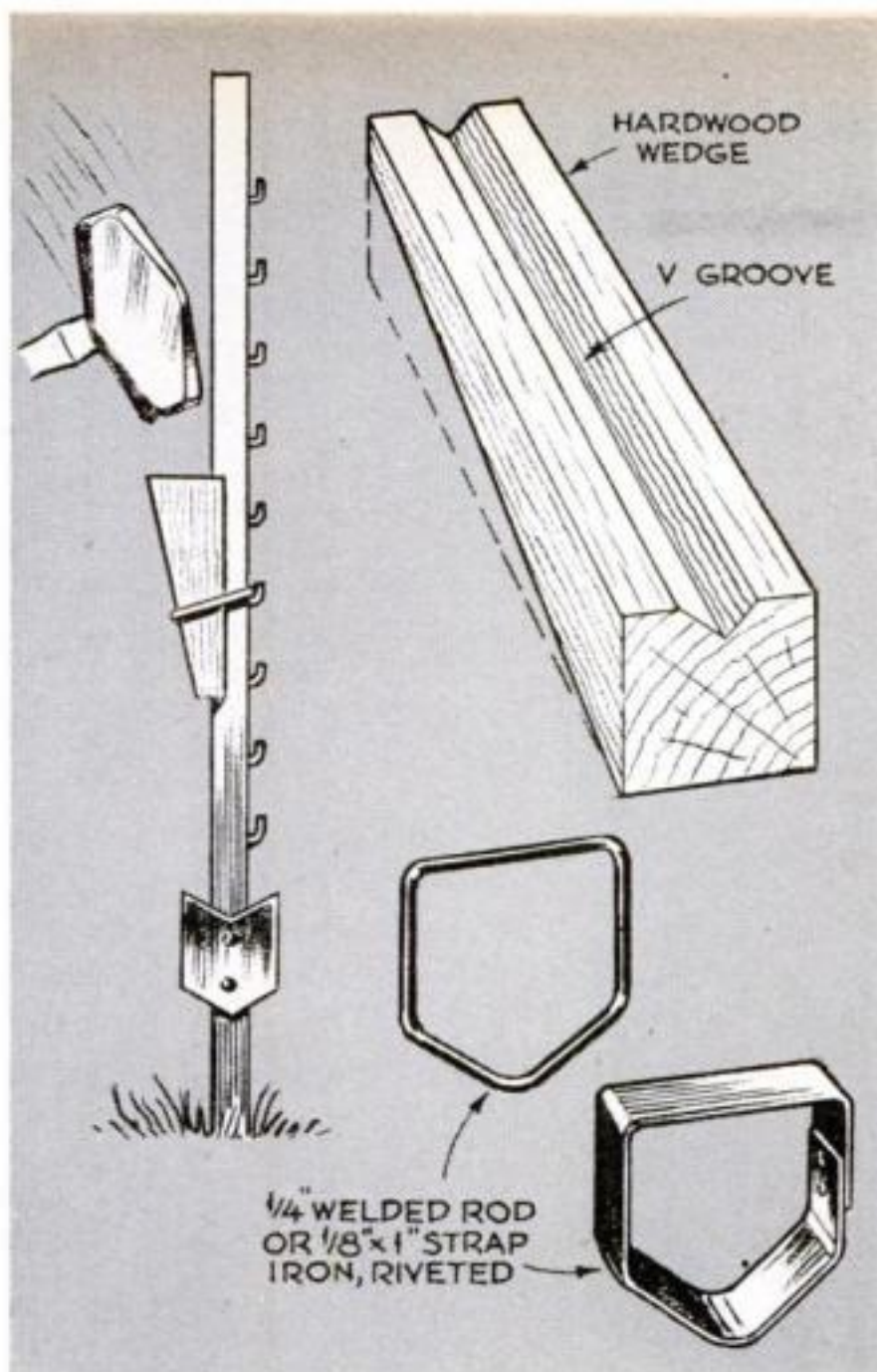
2 Adding an "instant" reverse. This will let you reverse a motor while it's running—not possible where starting coils are controlled by a centrifugal switch. It's a big help on delicate operations, such as threading, where it's hard to allow for the motor to coast to a stop. The trick is to add a pushbutton switch across the centrifugal switch to short it. You start the motor as usual, then flip the main switch to "reverse." The motor

will run forward until you push the auxiliary switch; then it reverses instantly.

Connect two leads to opposite sides of the centrifugal switch (white wires in left photo), and run these to a push-button switch in a junction box (above). Use a heavy-duty switch rated for the motor; the common ampere-rated snap switch won't handle the load. Mount it where it can't be accidentally bumped.—*John J. Jones, Drexel Hill, Pa.*

Short Cuts and Tips

FROM PS READERS



Wedge Sets Fence Post

A GROOVED wedge locked in place with a metal ring makes it easy to drive metal fence posts. The wedge tightens on the post when struck with the sledge, but a light upward tap loosens it. The ring can be made of $\frac{1}{4}$ " rod or scrap iron.—*A. E. Bryant, Lynchburg, Va.*

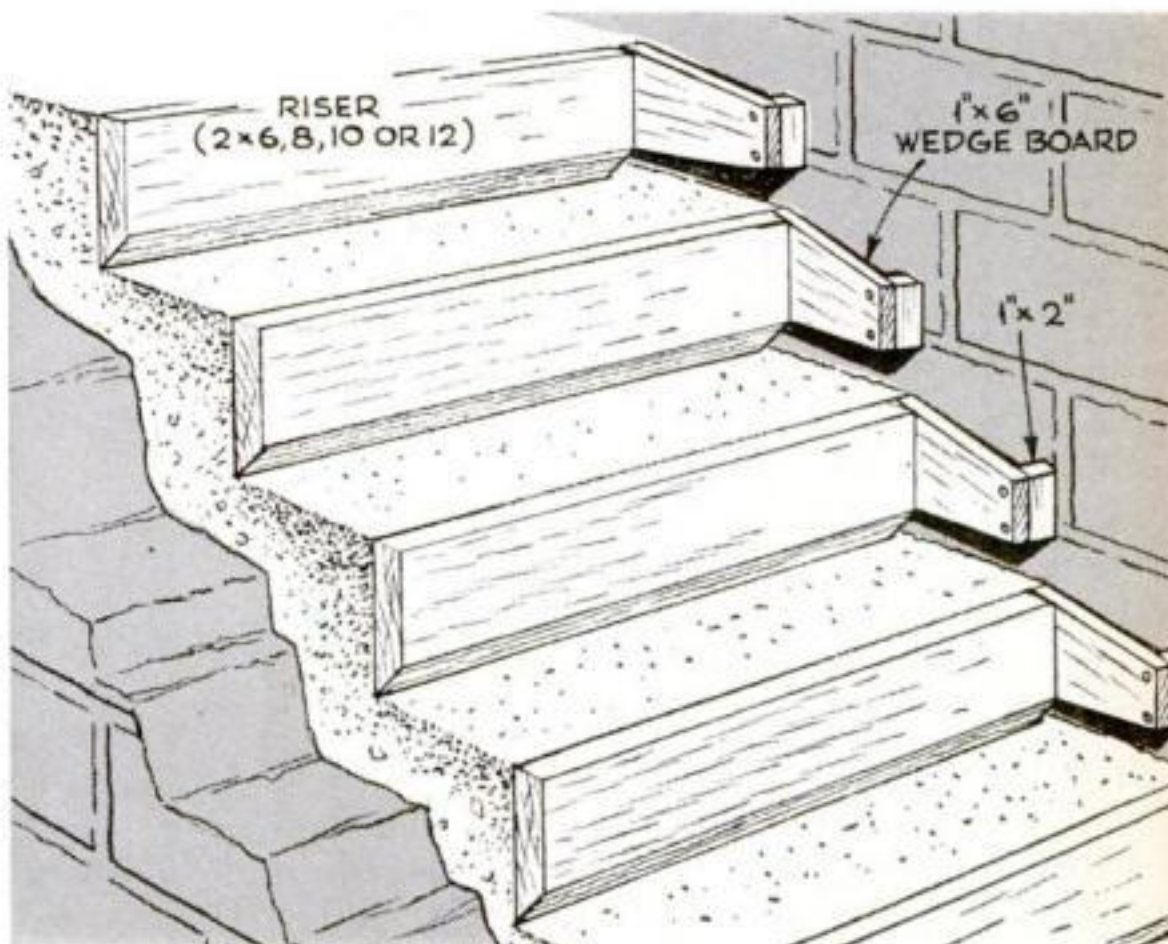


Pinching Brad Stops Bends

DRIVING brads into hardboard is difficult because many bend. Pinching the brad tightly between thumb and finger prevents bending while the surface layer is pierced. The trick works for driving very thin brads into any material.—*Jackson Hand, Westport, Conn.*

Wedge Forms for Concrete Steps

NEED to pour concrete steps between two masonry walls? Avoid nailing the forms in place. The risers can be wedged in tightly by prying with hammer or crowbar behind one-by-sixes placed at one end. Insert one-by-two blocks and tack them lightly to the wedges. Cut the risers about $\frac{7}{8}$ " short. Bevel each riser's bottom edge and cut the wedges at an angle so they won't interfere with finishing the treads.—*Gary Loshman, Cedar Falls, Iowa.*





**"Imagine *listening*
to our movies
as well as
seeing them!"**

YOU WON'T BELIEVE IT till you hear it—the rich, clear-as-a-bell sound of the Kodak Sound 8 projector!

Make your 8mm movies come alive

Now you can add rich, stirring sound to your 8mm movies—new or old. And you can use your present camera.

All this is made possible by Kodak's discovery of a way to put quality magnetic sound on narrow 8mm film—and by the Kodak Sound 8 projector, which both records and plays back the sound.

You simply take your processed film to your dealer. Ask him to have a magnetic stripe, such as Kodak Sonotrack Coating, applied to the film edge.

As you project the "striped" film through your Sound 8 projector, talk into the mike to record voice commentary. For music and sound effects, hook in your record player or tape recorder.

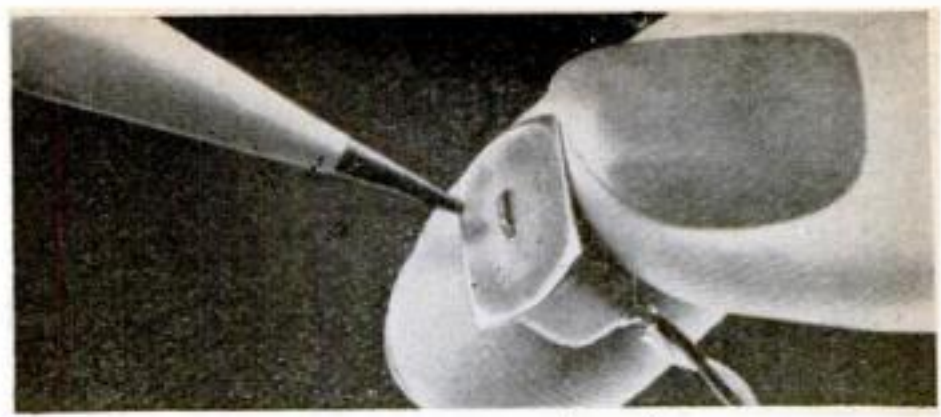
You can play back your new sound movie instantly. To improve any sections of sound, just reverse the film and re-record; erasure of previous sound is automatic.

Kodak Sound 8 projector, with microphone, long-play record and built-in speaker, is less than \$350. See your dealer. Many dealers offer terms as low as 10% down.



RECORD RIGHT ON THE FILM — voices or "live" sound effects through mike, music from your record player or tape recorder. Play back through projector's built-in speaker or your present hi-fi equipment.

Price is subject to change without notice.



SOUND PICKUP HEAD is only $2/100$ " wide. It would wear away fast if made of the usual magnetic alloy. Kodak head is of new, incredibly hard Alfenol alloy, will record quality sound for countless hours.



LONG-PLAY (33 $\frac{1}{3}$) RECORD OF BACKGROUND MUSIC and 13 special sound effects comes with your Kodak Sound 8 projector. It's high-fidelity, of course.



PROFESSIONAL 8mm sound films are now available for sale or rent. The Kodak Sound 8 projector operates at both 16 and 24 frames per second.

(Below) **TWO FINE INSTRUMENTS IN ONE:** the Kodak Sound 8 is a top-quality 8mm projector, also a fine sound system with frequency response 70 to 9,000 cycles (at 24 fps).

with sound!

500-watt internal-reflector lamp

reverse-still-forward control

on-off lamp switch

motor switch

high-low lamp switch

sound-level indicator

"now recording" warning light

jack for an external speaker

phono input

mike input

self-locking record/playback switch

volume control

400-ft. reel capacity for half-hour showings; fast rewind

sturdy self-contained case

f/1.6 lens, Lumenized

10" x 2" speaker

phono cord included

high-quality mike included

elevation knob

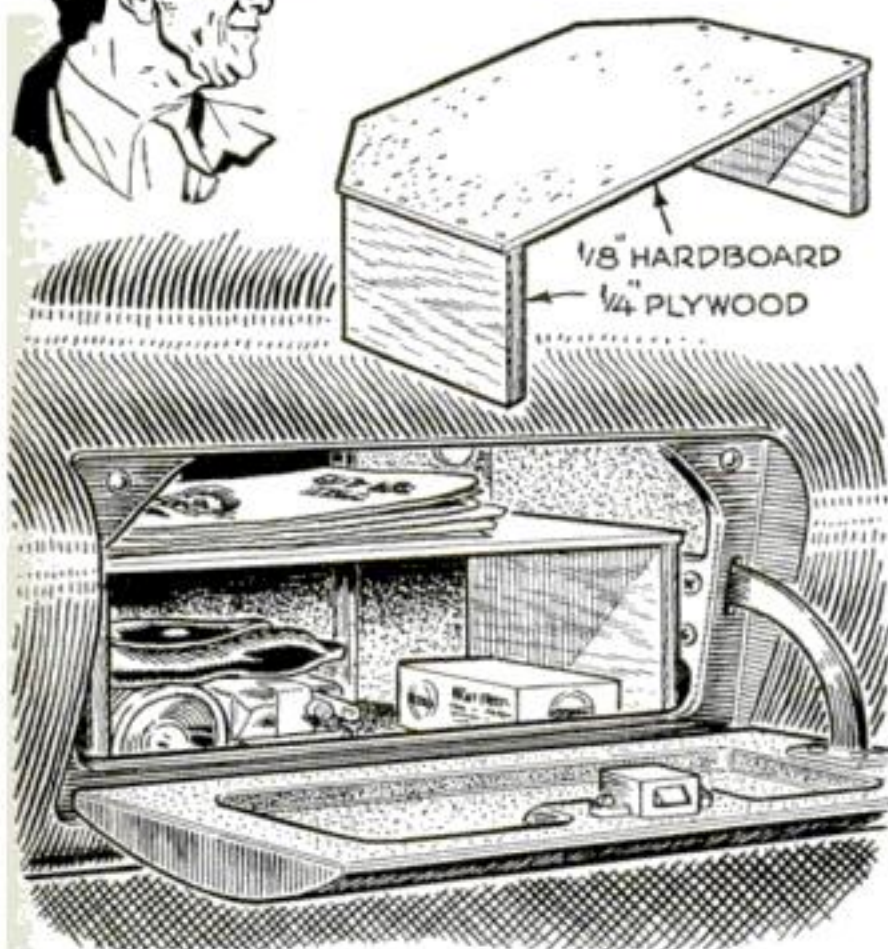
powerful amplifier

EASTMAN KODAK COMPANY, Rochester 4, N. Y.

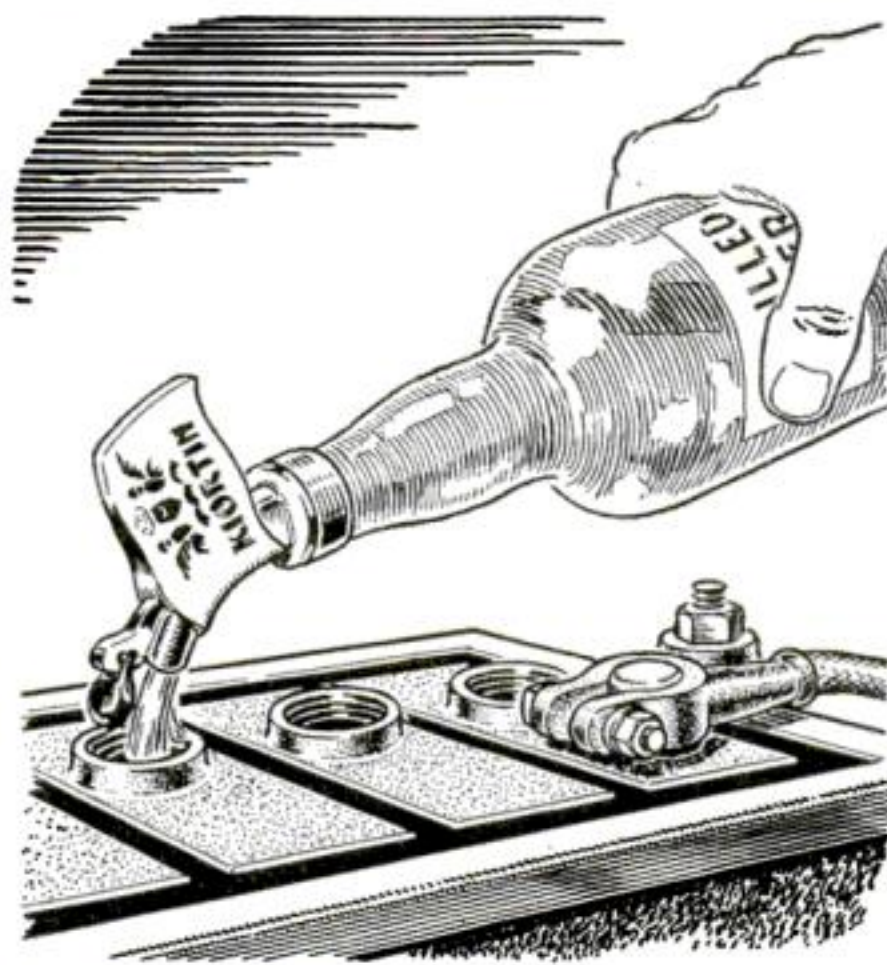
Enjoy Walt Disney's "Wonderful World of Color" Sunday evenings, NBC-TV

Kodak
TRADEMARK

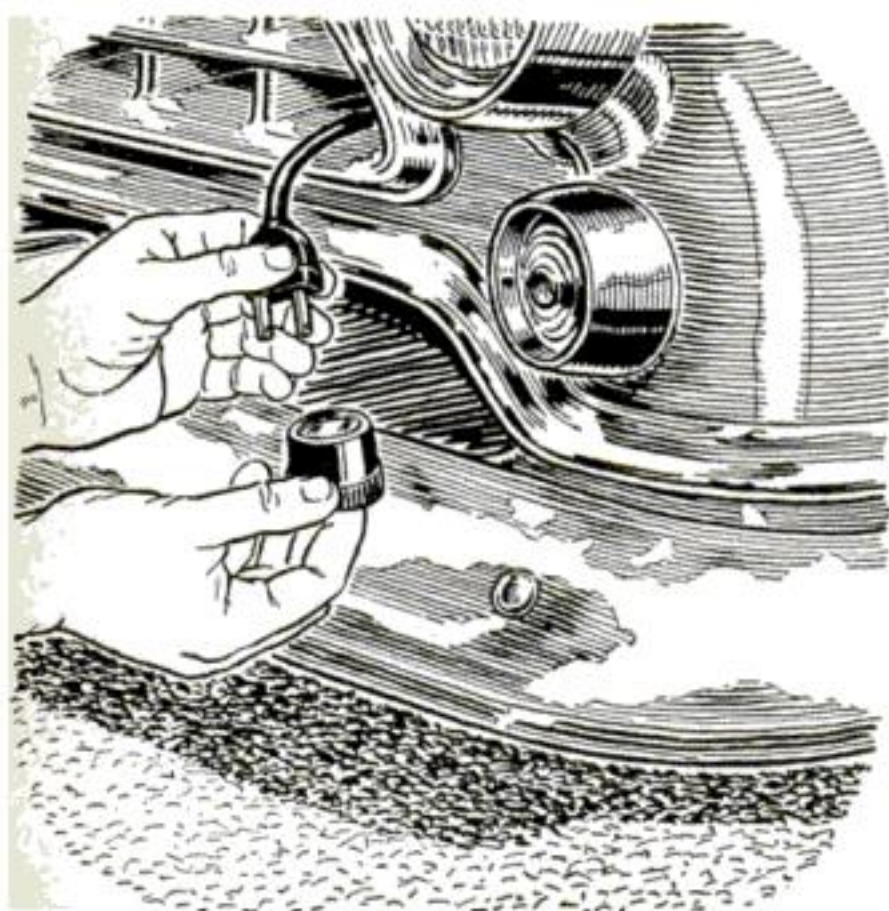
Hints from the Model Garage



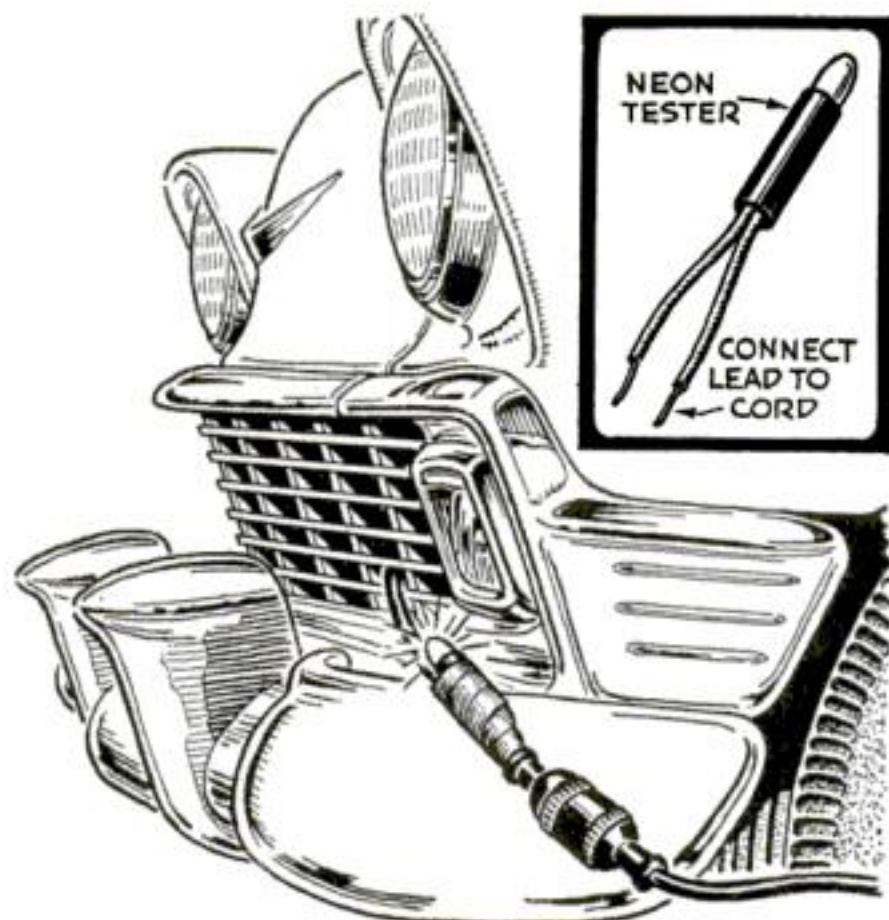
A glove-compartment shelf lets you make better use of limited space by filing road maps up out of the way. It's easily made of $\frac{1}{8}$ " hardboard with $\frac{1}{4}$ " plywood for the supports. Make a cardboard pattern first to insure proper fit.



Battery filling is neat and precise when you use a soda or liquor bottle capped by a whisky spout. These plastic spouts, with cork stoppers for snug fit, are often given away free by taverns and liquor stores for advertising purposes.



Engine-block heater plugs stay clean if protected by an electric-cord connector. The heater warms the water in the cooling system—a big help in cold climes—but efficiency is reduced when plug prongs are corroded by air or water. An-



other tip for engine-block heaters: To make sure the heater is working, hook up a neon-tube tester. Run the leads inside the heater-cord plug and tape the tester to the cord, covering all but the light. If the tester lights, you have current.



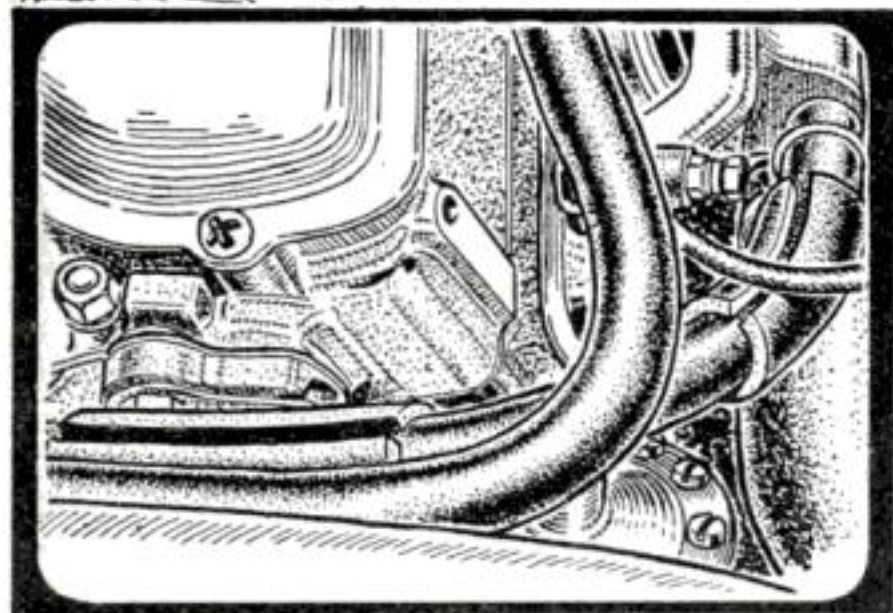
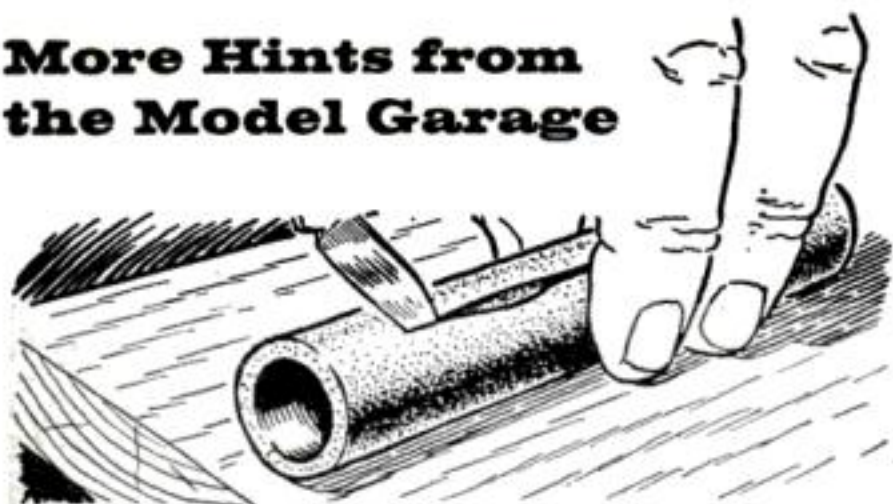
The exciting 1962 Chrysler 300 H at the Daytona International Speedway. Like all Chrysler-made cars, it is sparked by new silvery-plated Champions!

Chrysler has recently joined the long list of car manufacturers who use Champion spark plugs exclusively! (More than twice as many car makers the world over use Champions--because they deliver unmatched quality and performance.) Why settle for less in your car?



CHAMPION

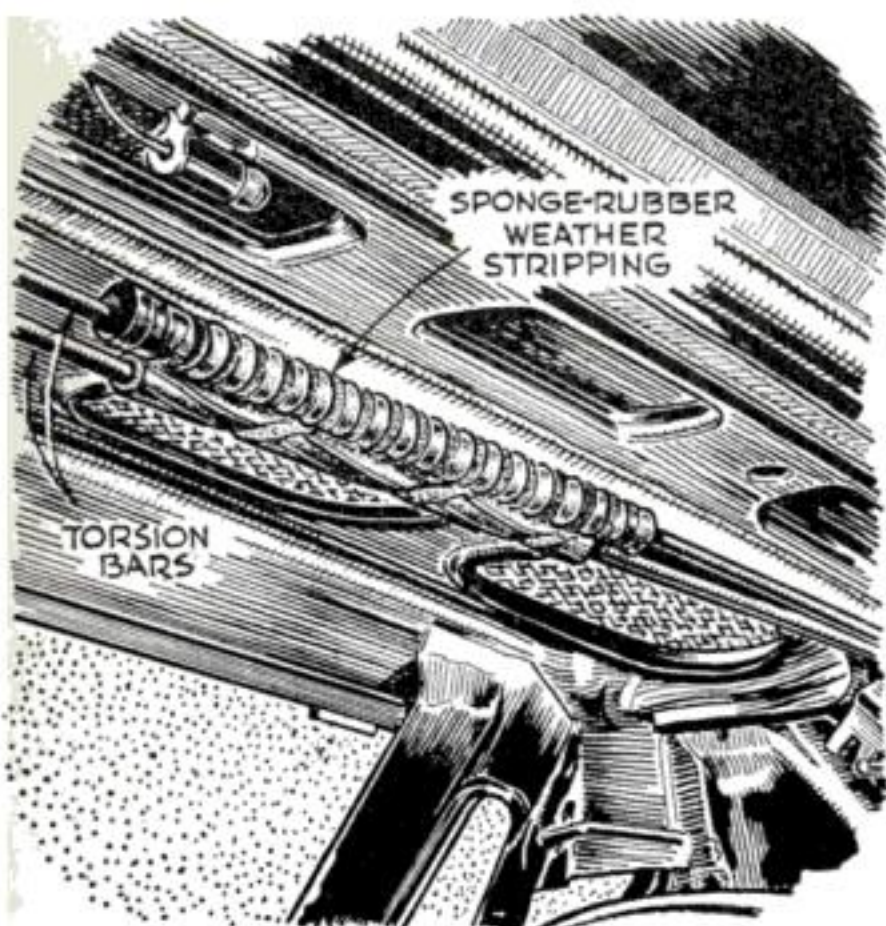
More Hints from the Model Garage



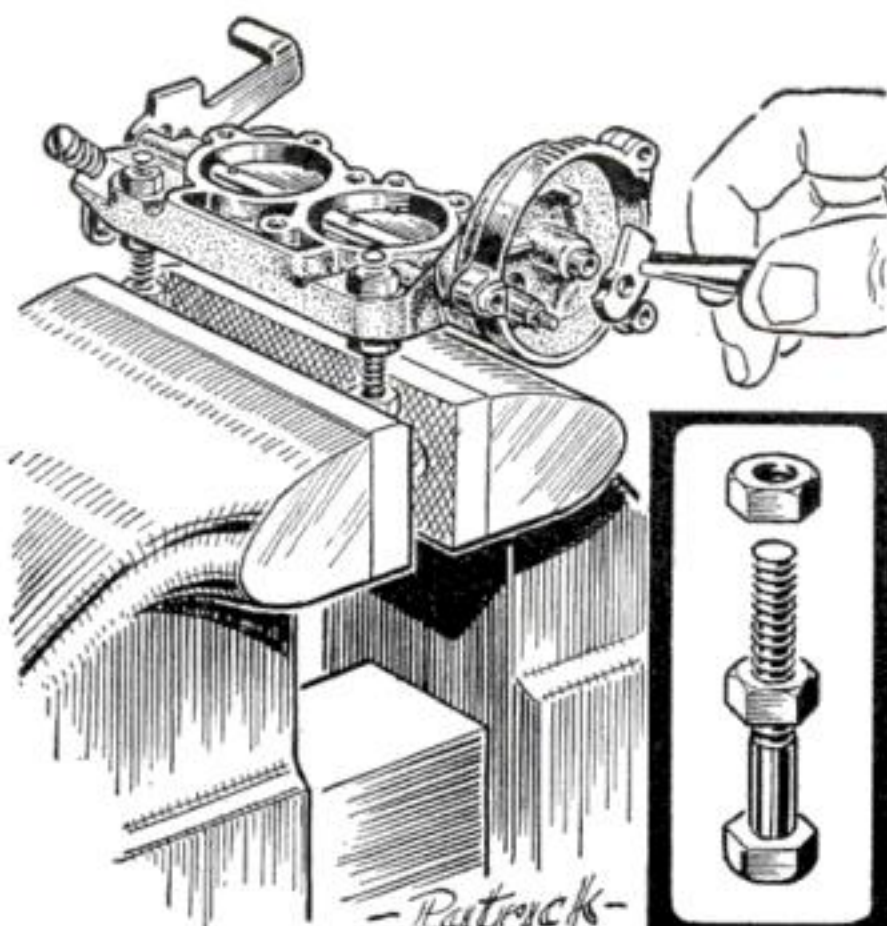
Installing new heater hose? Don't junk the old one. Cut it into short sections, slit it lengthwise, and slip it over the new hose at all points where it may wear against the oil lines or battery case. It will stay on without fastening.



Small four-cycles start faster in cold weather if warmed by a car's exhaust. Attach an old vacuum-cleaner hose to the car's tailpipe, and play heat around the engine cylinder and intake of your snow blower, tractor, or other machinery.



Noise under the deck lid on some cars may be due to rattling of the torsion bars that hold the lid up. If they hit against each other, wrap one rod with sponge-rubber weather stripping. Ends can be fastened with electrician's tape.



Securing a carburetor in a vise is necessary at times for repairs. To hold the carburetor firmly without damaging it, clamp two $\frac{3}{8}$ " bolts in the vise. Then bolt the carburetor to them through the mounting holes in the flange.

NOBODY KNOWS ENTHUSIASTS AS WELL AS CHEVROLET

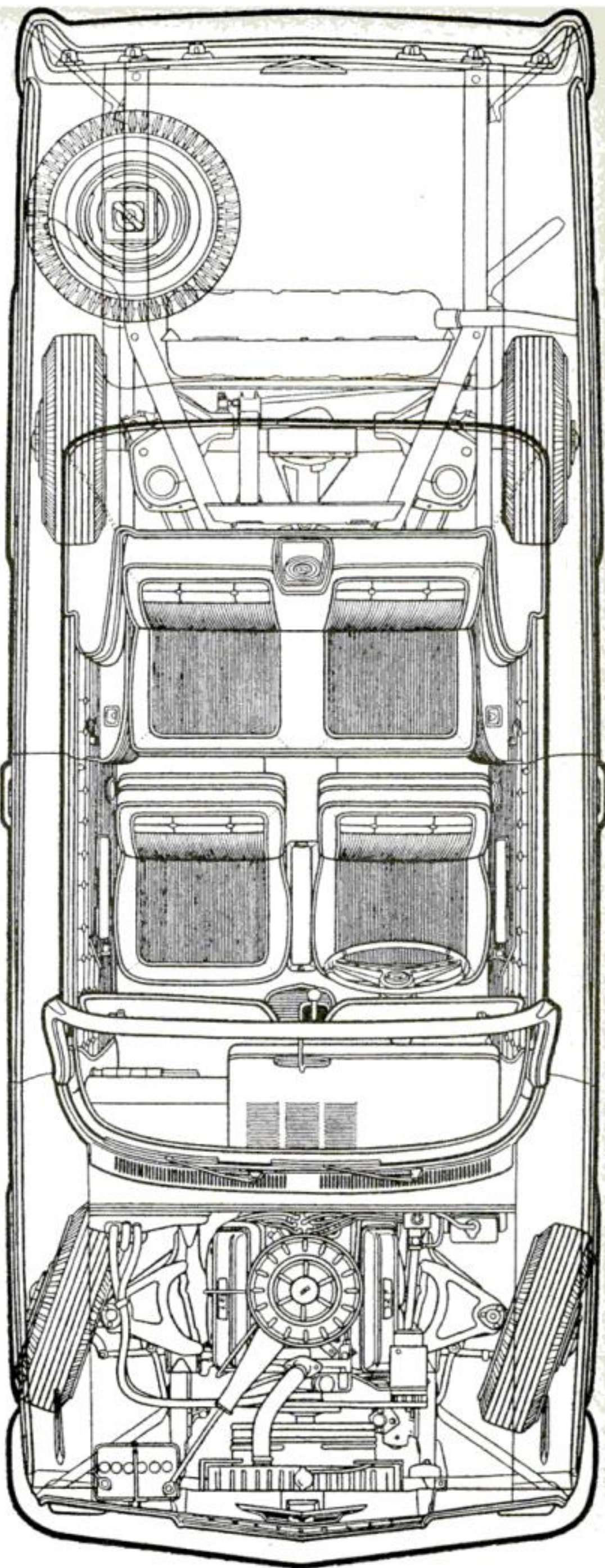
After all, who introduced the four-speed all-synchro transmission (one of the world's best) in American cars? Chevy. Who started the recent trend to bucket seats? Chevy did. Who built a real honest-to-goodness sports car back when hardly anybody else on this side of the Atlantic even knew what they were? Chevy again. Who pioneered Fuel-Injection for American cars? You guessed it.

Right now, Chevrolet builds a wider variety of models for discerning drivers than anybody, except perhaps a couple of European one-of-a-kind custom builders. Everything from frolicsome two-seaters to full-size family sedans, all available with a fantastic array of equipment designed to suit the more demanding driver.

Imagine a car like the Impala Sport Coupe with such optional-at-extra-cost equipment as bucket seats, four-speed box, any one of the great V8 engines, Positraction, heavy-duty shocks and springs, and sintered-iron brakes. It'll out-handle and out-run quite a gang of good automobiles, and it'll carry you, your wife, your mother-in-law, two kids, a bird cage and a springer spaniel in the process.

If you're a one-car man with a ten- or twelve-car appetite, try a combination like that—it's not bad, and it'll sure leave a trail of disillusioned sports cars in your wake. Chevrolet Division of General Motors, Detroit 2, Michigan.

CHEVROLET



Gus Sweetens a Sour Deal

By Martin Bunn





Stan froze, the wheel in his hands. Gus flashed a drop-light on the brake drum.

ROLLING out from under a car he was working on, Stan Hicks twisted around to look through the open shop door of the Model Garage. A car stopped at the curb, then took off again. Stan slid back under, whistling.

Walking over, Gus Wilson nudged a protruding foot until his helper emerged.

"What's the plot?" asked Gus.

"Er—no plot, Boss."

"Four mornings you've been edgy until somebody stops out there. Once he goes off, you're okay. How come?"

Stan wriggled, sat up. "It's Daisy Allen. She came in last Friday while you were out, said something was clicking up front. I drove around the block with her. Not a click."

"Is that all you did?"

"No, I checked both front wheels for a loose or broken bearing. All okay."

Gus grinned. "Knowing Mrs. Allen, I think you did fine. Why does she stop?"

Stan shrugged. "I'd hate to ask her. I figure she either imagined the noise or

heard a kid's bike clicker. But every morning since Friday she stops out there and then goes off again. Sort of bugs me."

"Okay, Stan. If she comes again tomorrow, I'll go out and talk to her."

With a glance blending pity and relief, Stan rolled back under the car.

LATE that afternoon a car Gus had never seen drove into the shop. From it stepped a gangling young man with red hair and a harassed expression.

"Hello, Herb," said Gus, recognizing the high school's auto-shop teacher. "Looks as if you made a trade-in."

"I was out-traded," said Herb Findley bitterly, "by a dealer named Wheeler." He kicked a tire morosely. "This is a clunker, a grade-A lemon, Gus. The engine won't run smoothly. Automatic transmission's probably shot. Wheeler's mechanics can't do a thing about it."

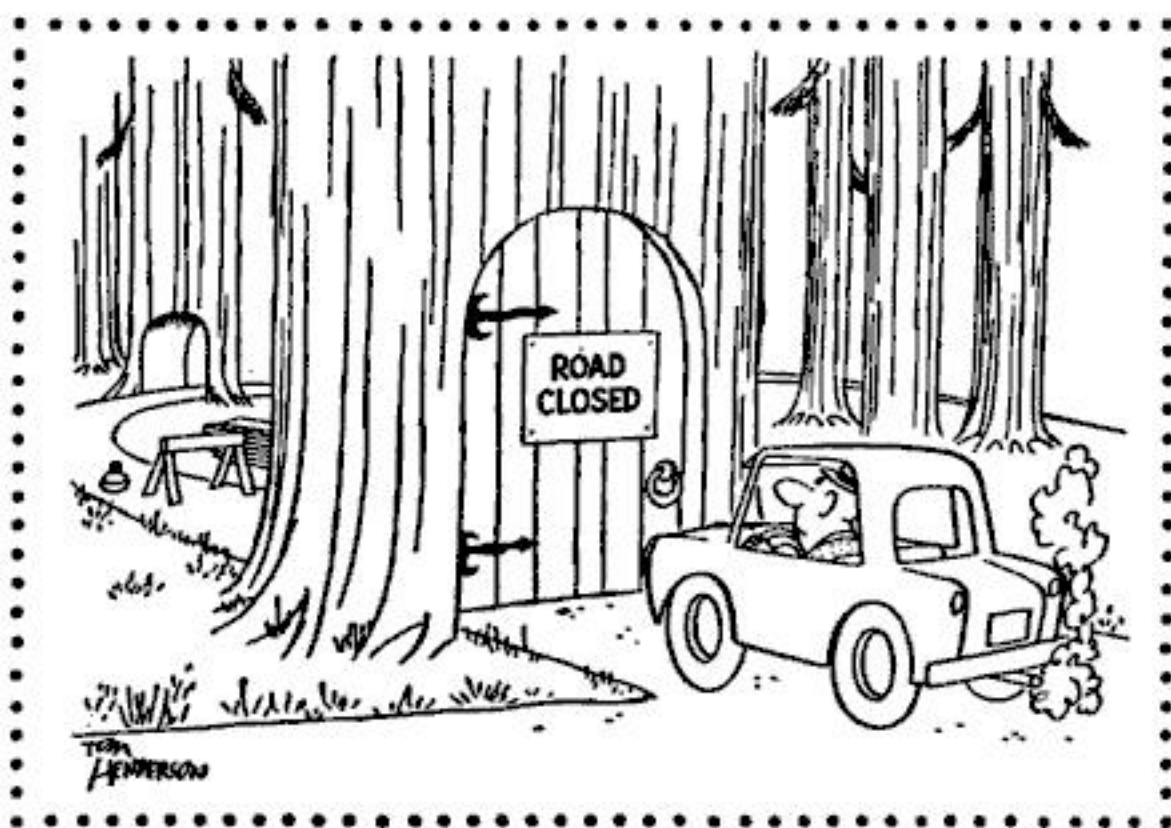
"You've got better equipment at the school shop than Zeb Wheeler has. Why don't you . . ." Gus paused.

"You guessed it," said the young teacher grimly. "I can't let my students find out I've been stung. Not and keep teaching. I've taken the car back to Wheeler three times. Now his guarantee is up and he won't even look at it."

"Well, I will," said Gus. "Maybe it's less serious than you think."

Findley shook his head. "It's the transmission, for sure. Kicks down with a bang when I slow down, shifts up with a clunk when I speed up. Took all my cash to buy the crate—I can't even afford seat covers for this worn upholstery. So if it needs a big overhaul, don't do it. I'll walk."

"Leave it and we'll see," said Gus.



NEXT morning Gus watched for Daisy Allen's car as expectantly as Stan. When it squeaked to a brief stop outside, Gus reached it in time to hail her.

"Heard you were in last week and we couldn't help you," he said.

"Oh, but you did, Mr. Wilson. Now I know how to stop the click."

"You do? How's that?"

"Well, if I drive to Middleton by the main road—that's where my club has its charity drive this month—it clicks at every traffic light. So I come down Bell Avenue, as I did Friday. After I stop here, it doesn't click any more."

Gus cleared his throat. "Mrs. Allen, why should coming here make it stop?"

Daisy Allen smiled, a pretty picture of confusion. "I don't know. But of course you do, so I'm not worried."

"Uh—of course. Doesn't it click when

you're driving home from Middleton?"

"Only down that long hill from the clubhouse. But I don't mind that."

"I do," said Gus. "How about leaving the car here today?"

"I'd love to! I'll do some shopping and ride over with Mrs. Taine later."

"I'll drive you downtown," said Gus, "and listen for clicks on the way."

CLICKLESSLY, Gus drove the car back to the Model Garage wondering whether he had made a fool of himself. Stan looked as if he was sure of it.

"All the same," said Gus, "you yank those wheels and see if a brake-drum bolt is rubbing. Clean out the bearings to look for a split or broken roller."

Stan shook his head. "Boss, I didn't hear it, you didn't hear it, and if she did it must be her head rattling."

"Want to go up to her house tomorrow and drive her here to make sure?"

Stan hastily jacked up the car.

FINDLEY'S car behaved just as he had said. It shifted up with a jolt, kicked down with a sharp jerk before coming to a stop. Gus had just put it

on a lift when the phone rang.

"Gus?" said Zeb Wheeler. "Findley walked by, so I asked him about his car. He says you've got it there."

"Only for a look," returned Gus. "If it needs a transmission overhaul, I suppose he'll do it in the school shop."

A grunt came over the wire. Gus could almost hear Zeb thinking; if Findley's plight became known to his students, every parent in town—and many used-car buyers—would soon be aware of it.

"Of course you know it's the transmission?" Gus threw into the silence.

"Was okay when I sold it," said Zeb quickly. "The car runs, doesn't it?"

"Like a scared rabbit with the hiccups," retorted Gus. "But your guarantee's run out, so why worry?"

There was a short pause. "Don't want to be hard on a customer, Gus. You fix

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it, and I'll pay up to 20 bucks—but no big overhaul, see?"

"What've you done so far?"

"Cleaned plugs, put in new points and condenser, adjusted the carburetor—oh yes, and put in a new wiper hose."

Something tugged at Gus's memory. "Expect that to fix the transmission?"

Zeb snorted. "A piece of hose between the intake manifold and some tubing on the firewall was spongy. My mechanic thought it was leaking air, making the engine idle rough. But it didn't help."

Gus took a plunge. "Zeb, I haven't even looked under the car yet, but you send over new seat covers and I'll fix it for what Findley can pay."

"All right. It's a deal, Gus."

"And, Zeb—you never replaced a windshield-wiper hose on that car."

"Eh? What you mean? Sure we did."

"No you didn't," said Gus, "because that year's model has electric wipers."

MOROSELY triumphant, Stan found Gus under Findley's raised car an hour later.

"I checked and repacked the wheel bearings, Gus. They're good. No sign of a bolt, nut, or shoe rubbing any place."

Gus rubbed his nose with his thumb knuckle. "Maybe Mrs. Allen *was* hearing things. Put the wheels back on."

Smugly satisfied, Stan went off as Herb Findley entered the shop.

"There's your big transmission job," said Gus, holding up a four-inch length of oil-soaked vacuum hose.

Findley stared. "Wheeler said he put on new hose. And I believed him!"

"He thought so, but his mechanic only changed a piece from the manifold to a line of tubing. This part, from the other end of that line to the transmission modulator, was cracked wide open. It let air in, making the engine run rough."

Gus let the lift down and added, "It

also killed the vacuum in the vacuum section of the modulator, which is supposed to regulate fluid pressure according to torque demands. Without vacuum, it couldn't, so you shifted with a bang."

Findley shook his head. "And me the one who tells students to think a job through. I knew about the modulator line, but took it for granted they'd renewed all of it." Suddenly his glance fell on Daisy Allen's car. "Say, that bus gave me a turn this morning."

"Me too," said Stan, who was putting the wheels back on Mrs. Allen's car.

"Coming to Bell Avenue I heard a clicking that made me think I had still more grief. But it was this car close behind."

"Sure it was this one?" asked Gus.

Findley nodded. "I saw that plastic parakeet over the windshield when she stopped alongside me. Then I could tell the clicking came from her right wheel."

Stan froze, the wheel in his hands.

Gus picked up a

droplight, went over and flashed it on the brake drum. Smoothly worn, it showed no ridges or scuff marks.

Gus angled the light in different ways. Suddenly he pointed to a thin, thread-like line starting under a nut and traced it out to the braking surface.

"A hairline crack," he said. "Each time the wheel turned—with the brake on—the lining stubbed against it."

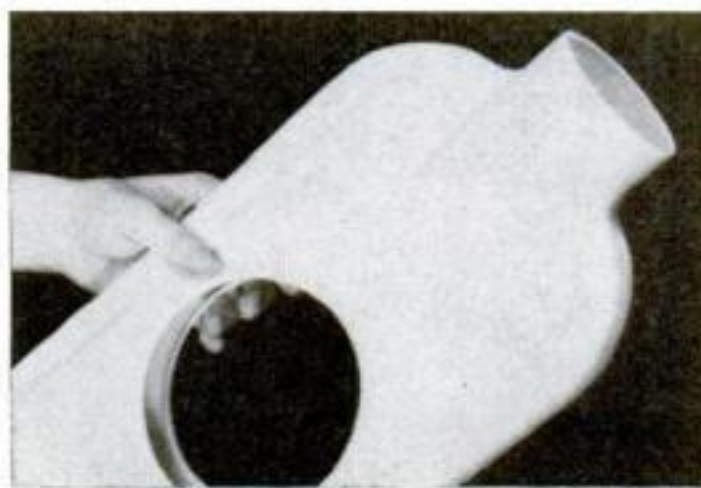
"Why didn't we hear it?" asked Stan.

Gus grinned. "Because she came down twisty Bell Avenue, where you have to brake hard and often. By the time she got here, the drum was so hot it expanded—and closed that thin crack."

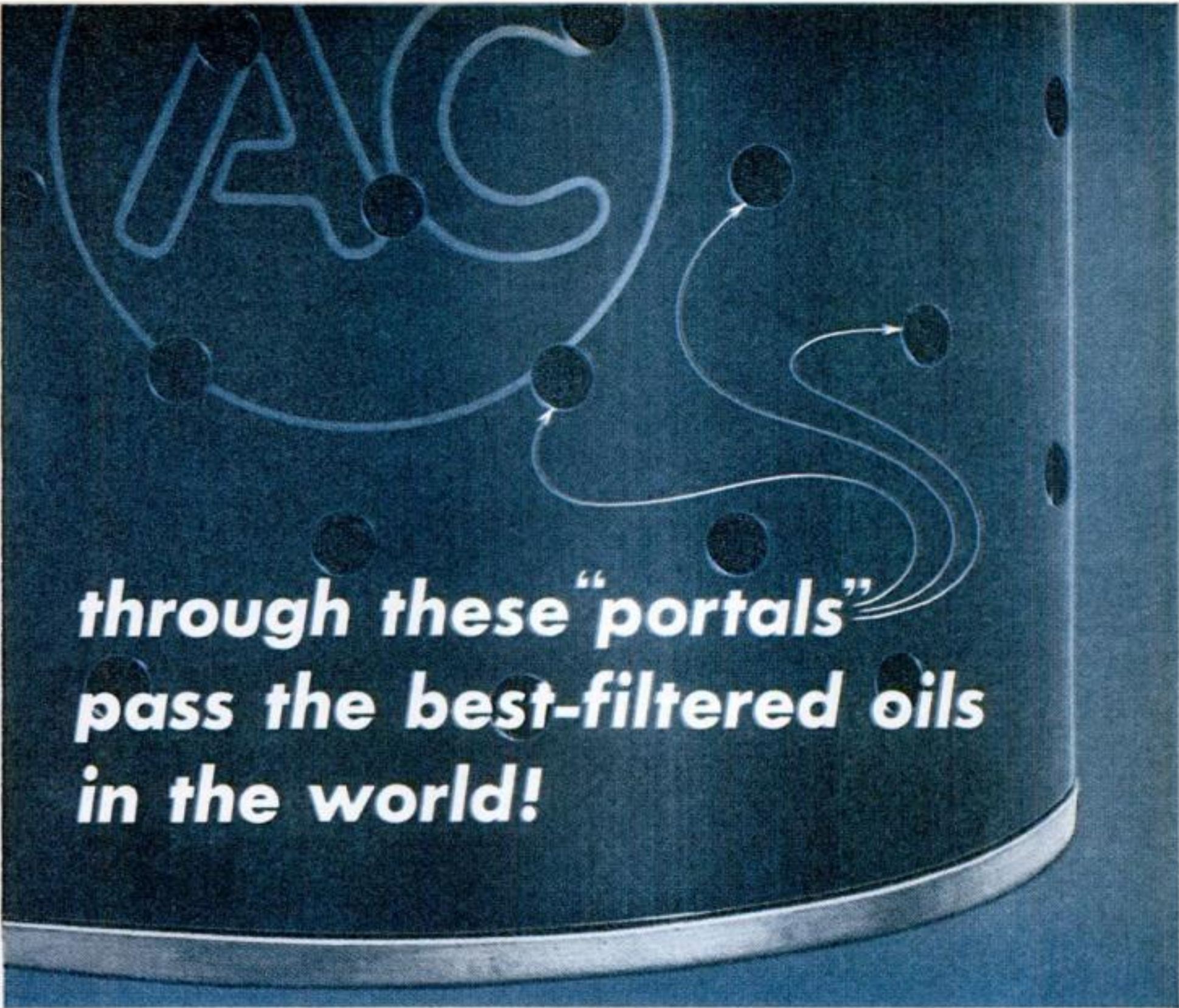
"That's one to tell my class," said Findley, going to his car. "Say, where did these seat covers come from?"

"A gift from Wheeler," said Gus. "All you owe me for is some hose and a carb adjustment." He nodded toward Daisy's car. "Your consultation fee on *that* wipes out my consultation fee on *this*." ■ ■

What is this?



ANSWER: It's a one-piece, seamless, translucent, polyethylene, traffic-light housing. What else?



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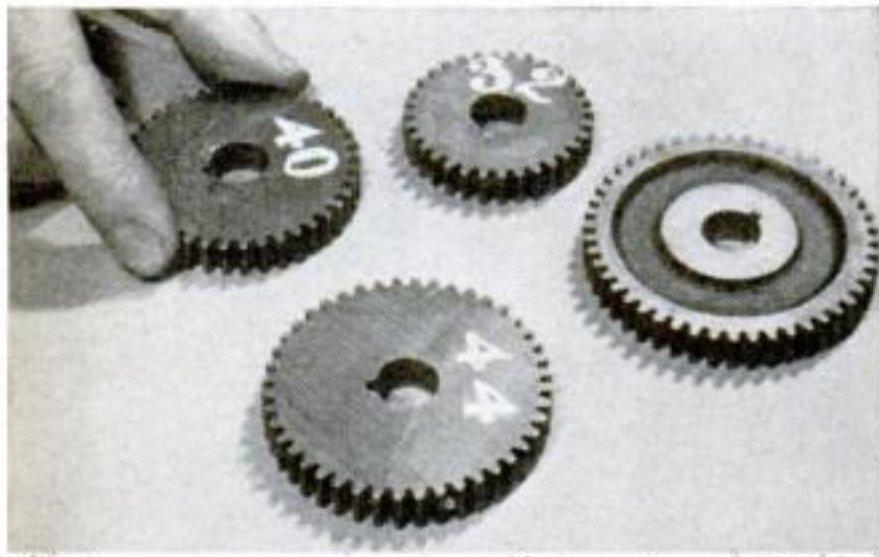
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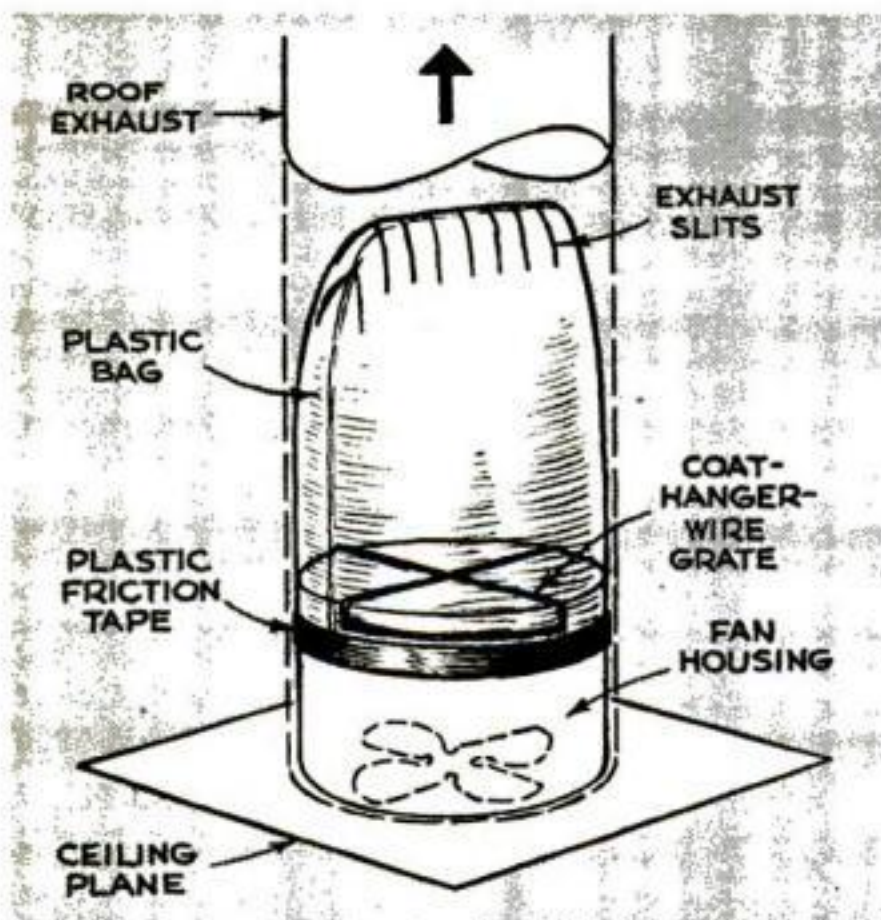
Short Cuts and Tips

FROM PS READERS



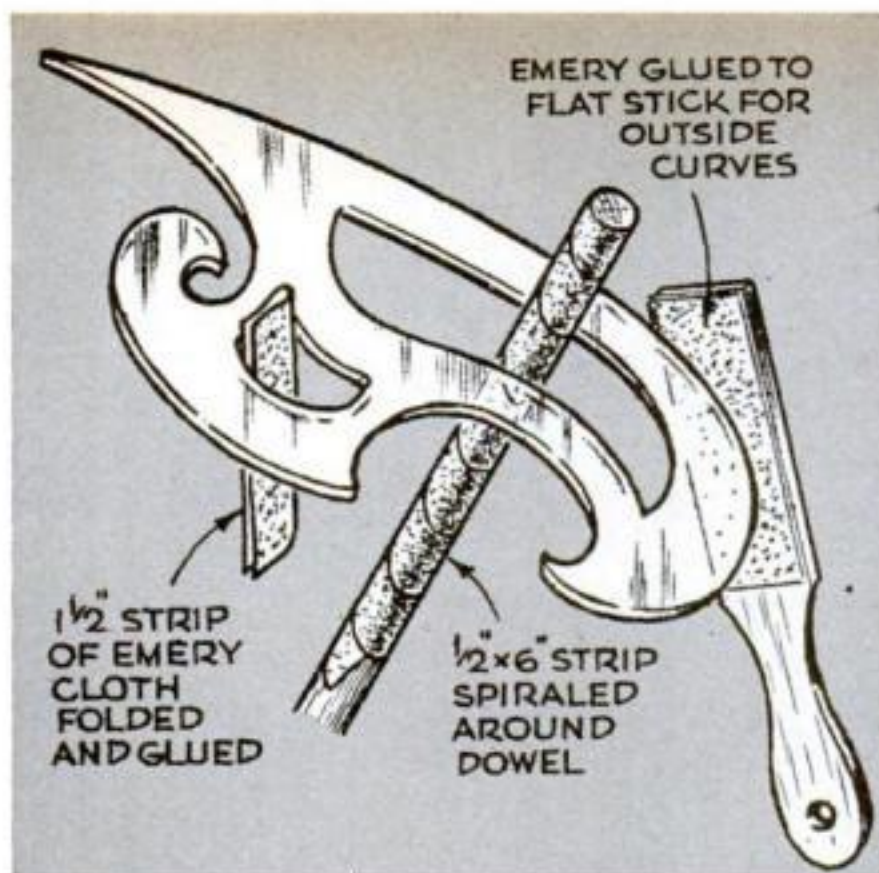
Numbering Gears for Storage

LATHE gears can be selected from an assortment more quickly if the number of teeth is indicated in bright paint on the side. The gear above at right has the usual small, stamped number, but who could spot it without a lot of trouble?—*Walter E. Burton, Akron, Ohio.*



Vent Valve from Plastic Bag

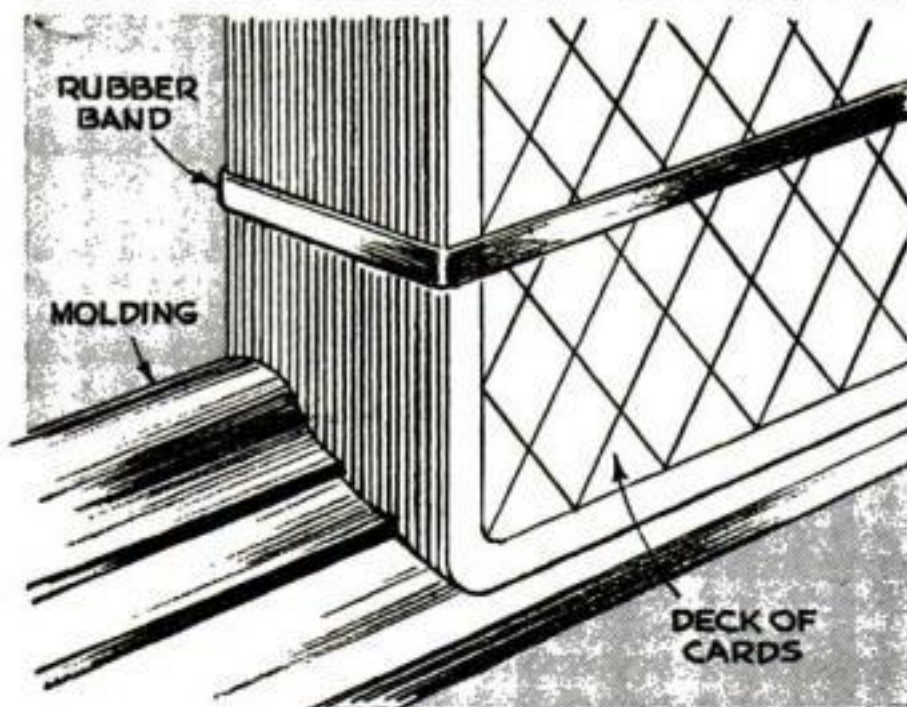
ICY blasts through the exhaust duct of my bathroom fan kept me in gooseflesh until I inserted a plastic bag. Where the duct joins the fan housing, I installed a wire grate. The fan keeps the bag inflated although the upper end is slit to exhaust the air. But when winter winds swoop down the vent, the bag collapses against the grate, sealing them out.—*Paul W. Fryar, Canoga Park, Calif.*



Reconditioning French Curves

AFTER years of banging around the shop, my set of transparent curve templates became too nicked to produce neat lines. I salvaged them by dressing the edges with fine-grade emery cloth, using long, diagonal strokes to preserve the curves.—*Jack Neill, Bellport, N. Y.*

▶▶▶ AN EMPTY ball-point pen barrel makes an inconspicuous shirt-pocket pill carrier. Cut it off below the clip and insert a cork.—*Sid Isaacson, Deer Park, Wis.*



Copying a Molding Contour

TO GET the pattern of a molding that's nailed in place (as when you want to cope a butting member to fit), try pressing the edge of a deck of cards against the contour. When the cards take the shape, snap a rubber band around them so you can lift them off and trace the pattern. With a piece of sandpaper folded around the edge, cards make contour sanding blocks.—*R. S. Tupper, Canton, S. D.*



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STANLEY

THE TOOL BOX OF THE WORLD

it is. Soft springing might make it pitch all over the landscape.

Luckett: The ride isn't as hard as you make out. With several people aboard, it's fine.

Comstock: There's an engineering point here—the bigger the percentage of disposable load, the harder the springing has to be.

Allaway: This is an ingredient of what the car is—basic transportation. They've cut out the frills.

The Performance

Rowsome: Basic, but good. She'll go if you ask her to. I averaged 64 miles an hour on one 400-mile run.

Allaway: I averaged 50 miles an hour for six days, including food, fuel, and comfort stops.

Francis: I'll second that. The engine's a delight.

Comstock: It responds for passing.

Markovich: It's spunky.

Luckett: It doesn't buck at all in high gear at 20 m.p.h.

Rowsome: The car is willing to cruise at 75 indicated. It does get a little noisy and hysterical above that.

Francis: Even so, it will top 90.

Design and Construction

Comstock: This is the subject I've been waiting for. Anybody pinch his fingers in those door pulls?

Allaway: Most of us, I imagine. I did.

Markovich: The signal cancellation on turns was a sometimes thing.

Francis: So was the dome light, operated by the door switch.

Allaway: The shift linkage rattles on rough roads.

Francis: And the lever clunks going into gear.

Rowsome: Now that you've unloaded your beefs—

Comstock: I'm not through yet. You get road rumble from the body at high speeds?

Allaway: That seems to be one of the penalties of unitized construction. Still, in sum, small squawks aside, I'd say the design is good.

Rowsome: The Rambler is, all told, an appealing car. Kind of puppylike, but still likable. That little engine is real

willing and it starts instantly in the coldest weather.

Safety and Comfort

Luckett: The visibility is first rate.

Markovich: That's because you sit up so high. The seat's like a pickup truck's.

Rowsome: The heater's an abomination. There's plenty of heat, but it takes a long time to learn to control it.

Francis: I could never modulate it. I was forever fiddling with the fan and the push-pull control. For 100 miles in Kansas the heater broiled my accelerator foot. When I cut down the temperature I froze my front-seat passenger.

Rowsome: There's a trick. You move the thermostat control about 1/64 of an inch at a time.

Allaway: You don't get any heat by ram air even when you're traveling fast. You have to keep the blower on.

Markovich: Every time I got into city traffic, the engine temperature dropped a bit. Has that two-year radiator coolant got anything to do with that?

Luckett: I doubt it. My biggest peeve was noisy vent panes at high speeds.

Allaway: There's a trick to that, too. You cinch them down, using the pasteboard from a book of matches for a shim.

Comstock: Nobody has mentioned what bothered me most—the reflections of the panel lights in the windshield at night. They bounced off the chrome on the steering column and wheel.

Rowsome: I think the windshield reflections constitute our only major grouse on safety. Let's not forget a hidden asset, either. That's the new brake reservoir, split between the front and rear wheels. If one set of brakes fails, the other's in reserve.

In Conclusion

Allaway: This is a sturdy, solid, dependable little automobile, comfortable to drive.

Rowsome: It's a good buy for what it's built for—transportation, not a status symbol.

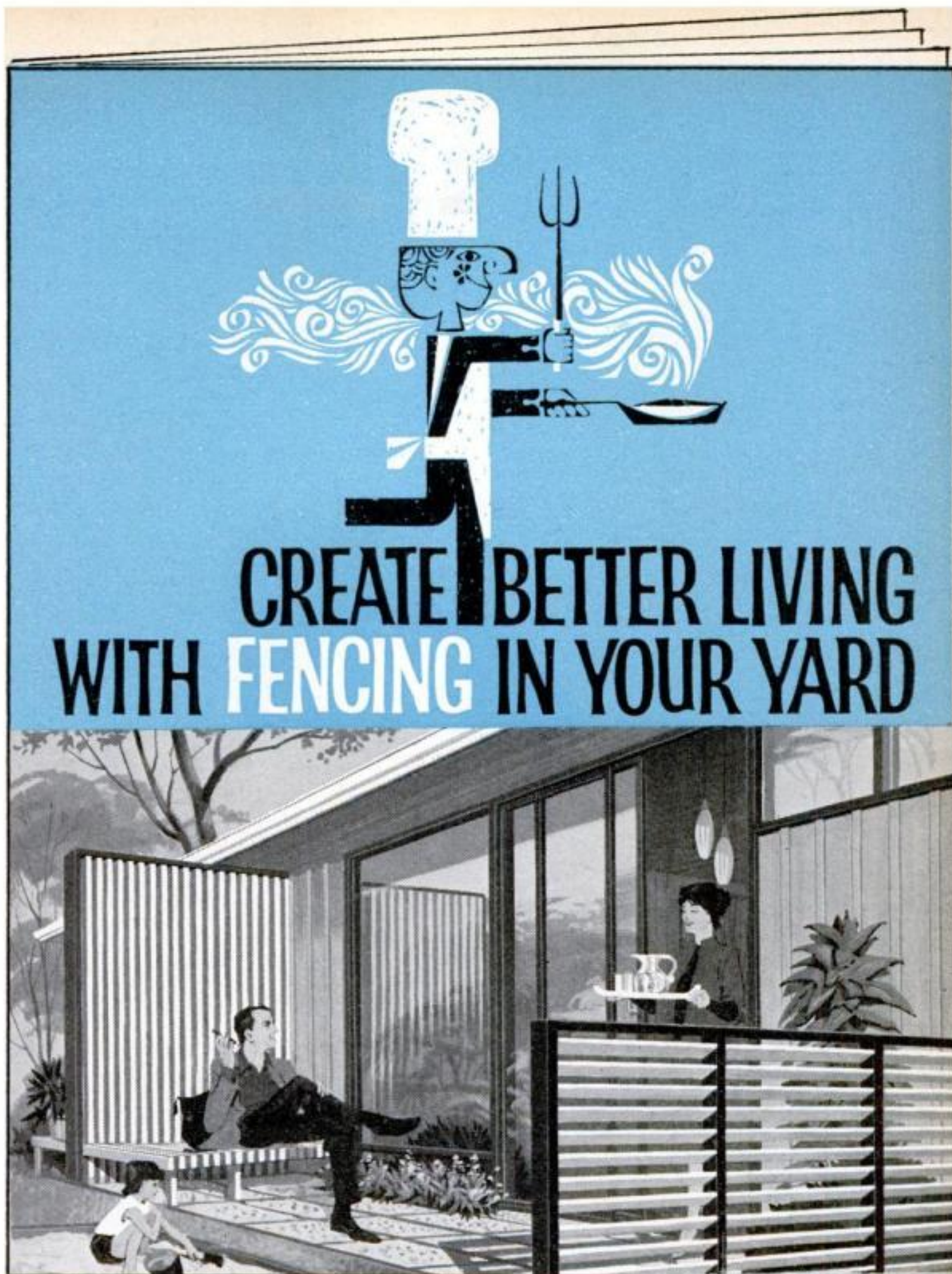
Markovich: And bearing in mind that it's a maverick by Detroit's standards.

Comstock: That's bad?

Rowsome: That's good. We need more mavericks like the American. ■ ■

WHITE FIR

ENGELMANN SPRUCE



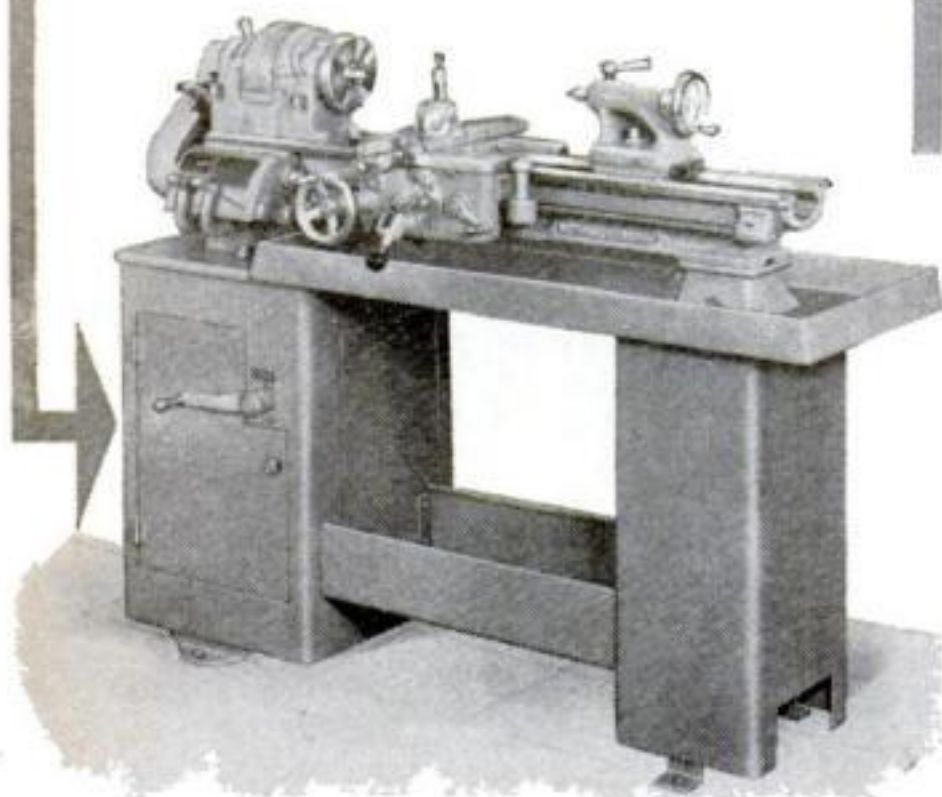
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There's more to Pontiac's new Tempest LeMans than its bucket seats, comfortable as they are, or its full carpeting and special trim, handsome as they are. The real bomb in this baby lies up under the hood.

The standard four comes in 110, 115, 120 and 140 h.p. versions. But if you're willing to lay out a few dollars more, you can have yourself a four-throated version of Tempest's 194.5 cubic inch mill. This little jewel puts out more torque than any other production four in the world—215 ft.-lbs. at 2800 rpm. Maximum h.p. reads 166 @ 4800—again, more h.p. than any other production four in the world. That's a horsepower jump of 11 over last year. Those eleven horses come from improved carburetion, better velocity and distribution in the intake manifold and a freer breathing exhaust. It takes premium fuel, and it delivers premium performance.

Next time you've got a few minutes, drop in at your Pontiac dealer's and borrow a new Tempest for an hour. If he doesn't happen to have the four-barrel job handy, either the standard 4 or optional V-8 engine will do fine, just fine. Go find yourself some road and ease open the throttle.

And then see if you can say no to Tempest.

TOTAL TORQUE MULTIPLICATION* WITH TEMPEST POWER TEAMS

TRANSMISSION GEAR RATIOS	REAR AXLE RATIO CHOICES				
	3.08:1	3.31:1	3.55:1	3.73:1†	3.90:1†
3-SPEED MANUAL					
1st—2.94:1	N.A.	9.73:1	10.44:1	10.97:1	11.47:1
2nd—1.68:1	N.A.	5.56:1	5.96:1	6.27:1	6.55:1
3rd—1.00:1	N.A.	3.31:1	3.55:1	3.73:1	3.90:1
Reverse—3.32:1	N.A.	10.99:1	11.79:1	12.38:1	12.95:1
4-SPEED MANUAL					
1st—3.65:1	11.24:1	12.08:1	12.96:1	13.61:1	14.24:1
2nd—2.35:1	7.24:1	7.78:1	8.34:1	8.77:1	9.17:1
3rd—1.44:1	4.44:1	4.77:1	5.11:1	5.37:1	5.62:1
4th—1.00:1	3.08:1	3.31:1	3.55:1	3.73:1	3.90:1
Reverse—3.66:1	11.27:1	12.11:1	12.99:1	13.65:1	14.27:1
TEMPESTORQUE AUTOMATIC					
Low (Plus Converter) 3.64:1	11.21:1	12.05:1	12.92:1	13.58:1	14.20:1
Low (Gears Only) 1.82:1	5.61:1	6.02:1	6.46:1	6.79:1	7.10:1
Drive—1.00:1	3.08:1	3.31:1	3.55:1	3.73:1	3.90:1
Reverse—1.82:1	5.61:1	6.02:1	6.46:1	6.79:1	7.10:1

*The higher the total torque multiplication figure the faster the engine will be turning at a given road speed and the livelier the performance.

†Must be special-ordered.

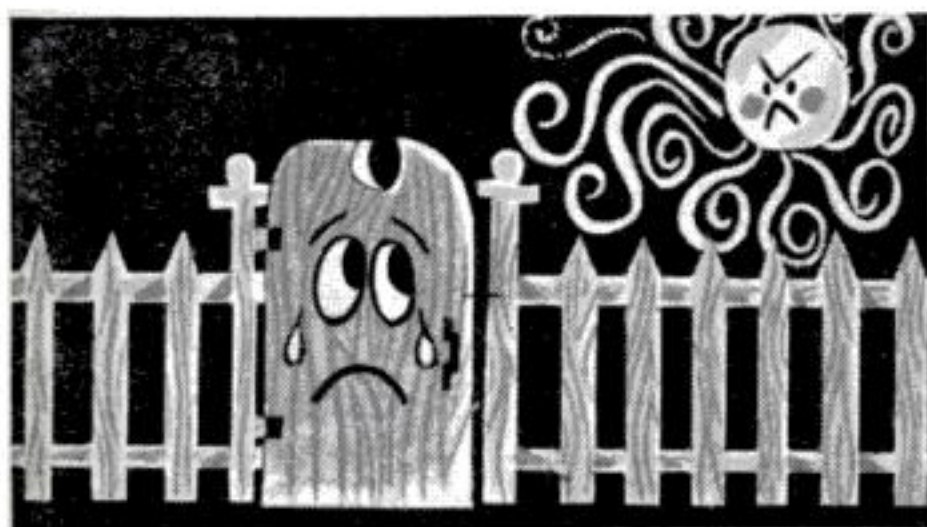
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Products of United States Plywood

Car Banks Into Turns Like a Plane

[Continued from page 81]

somewhat, but then a penalty must be paid: Independent motion of the front wheels is restrained and ride suffers. But the Westinghouse suspension automatically pushes up on the body at the outside wheels and pulls down on it at the inside wheels in a curve. Thus part of the car's weight is thrown back onto the inside wheels and the car banks into the turn, against centrifugal force. A sway bar is unnecessary.

"Let's run downstairs and take the car out for a spin," Osbon said.

A Merc with a difference. I was in for a surprise. The car had no futuristic, mile-high fins. Not even a bubble canopy. Just a stock-looking, slightly dusty 1958 Mercury. The interior also looked like any other Merc's, except for two extra gauges showing supply and return-line pressures.

"Those are for test purposes," explained Osbon. "They won't be necessary in consumer installations." He handed me the ignition key and slid in beside me.

The engine came to life with a piercing whine. "That's the oil-supply pump," he said. "But the noise shouldn't be too hard to cure—so far we've been concentrating on making everything work properly.

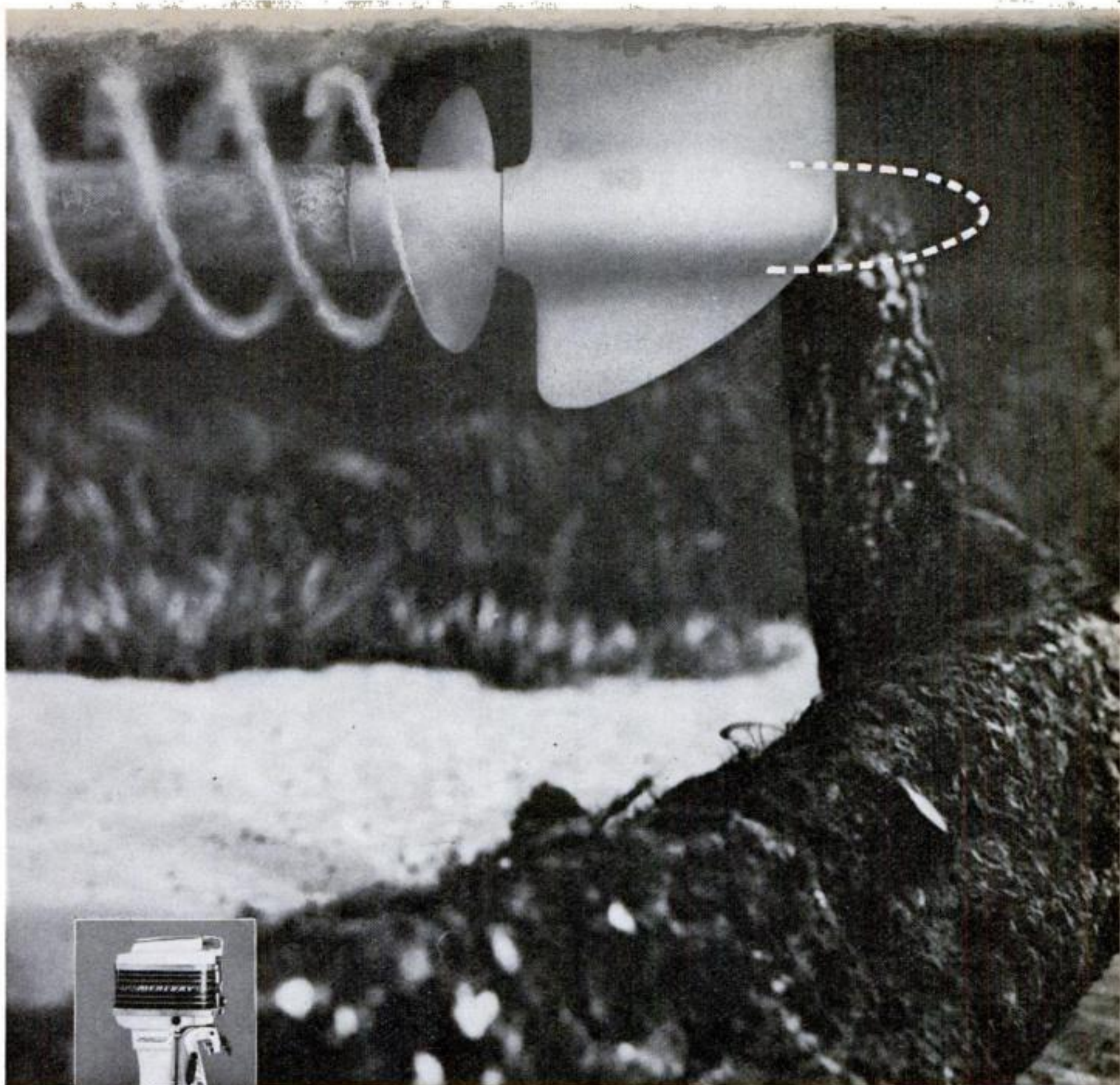
"Our former associate director of research, Dr. Clinton R. Hanna, got the basic idea for this stabilizer about 30 years ago. His early work was on trains as well as cars. The system in this car is only about four years old. A few minor details still have to be ironed out."

As we got rolling, the noise died down considerably. The road changed from smooth surface to gentle washboard, but the difference could barely be felt inside the car. Occasional potholes and bumps produced only the mildest vibration.

I remembered that the news release had promised no nose dive during braking. I warned Osbon to brace himself, hit the brakes hard, and prepared myself for the broncolike buck for which those old Mercs were noted. The car remained dead level as it slid to a stop.

I shook my head in disbelief, and tromped on the gas. No tail-end squat, I noticed.

"Try the shoulder," Osbon suggested,



Photographed underwater at Florida's Silver Springs



No Snag, No Drag

Ever take a fish's-eye view of a Mercury? It may give you a new slant on the differences between outboards.

The Merc four- and six-cylinder motors have a streamlined one-piece lower unit that glides over unseen obstacles. There's no protruding nose to snag on weeds, logs, or trotlines.

And, speaking of lower units, did you know that a driving propeller creates a vacuum behind its hub? It does. And, this vacuum cuts down mph and mpg.

Not so with Merc. Merc's exhaust fires out the center of the prop, destroying the drag, burying the noise and fumes. (We call it "Jet-Prop.")

No snag, no drag with Mercury. Just more RUN for your money!

MERCURY

100-, 85-, 70-, 50-, 45-, 25-, 9.8-, and 6-horsepower outboards

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Car Banks Into Turns Like a Plane

trying to check his Cheshire-cat grin.

I looked skeptically at the pock-marked strip, twisted the steering wheel, and got both right wheels off the road. The tires thumped a steady staccato as they battled the craters, but the ride was barely changed.

"Recently," Osbon said, "a company VIP asked me to give his young son a demonstration ride. We drove off the road and down a bumpy hillside. The kid loved it. He thought it was part of the demonstration. I didn't tell him that the accelerator had stuck."

The road gradually became more and more steeply crowned, but the car didn't seem to tilt to the right at all. To confirm my suspicions, I stopped the car and switched off the ignition. The car remained level as the oil-pressure needle began swinging down. A few seconds later, with a soft whoosh, the car sagged to one side. Restarting the engine brought pressure up again, and the car leveled off.

Osbon simply sat back quietly and smiled like a proud papa.

Coming 'round the bend. The unusual cornering behavior of the test car was dramatically illustrated a few seconds later as we entered a long, sweeping bend. The body dipped over the inside wheels and lifted on the outside. The road felt as if it were banked, though actually it was crowned. An approaching motorist, his eyes as big as clocks, almost drove into a ditch while he watched us go by.

That big, softly sprung Merc just had no business handling that well, I thought as I approached another bend. This time I gave the car more gas. The car didn't bank, but remained absolutely level. Halfway through the turn I kicked the accelerator down all the way. A mild lean became noticeable, but by now the tires were squealing.

The stabilizer had finally been overridden. But it was still doing its job—improving tire-load distribution and keeping lean down to minimum.

When we pulled into the Westinghouse garage, I launched a volley of questions.

"Can the system be adjusted to provide banking at higher cornering speeds?"

"Yes," answered Osbon, "at some sacri-

fice in handling. We feel the present adjustment is just about the best compromise for the average motorist."

"How much power is used to run the pump?"

"Only about five horsepower on a fairly rough road—less on smoother roads. That's less than the load of an air conditioner."

"What happens in case of failure? Is the motorist stuck?"

"No," said Osbon. "If a controller or actuator fails, the ride may be impaired and there may be rattles. If we lost our oil pressure, the car could still be driven, but it would handle like a wet noodle."

"How reliable is the system?"

"We've had a few failures during the system's development. But we've learned plenty from them. Once the stabilizer is ready for production, it should be practically troublefree."

"How much extra would the buyer have to pay to get the stabilizer on his new car?"

"It's too early to say definitely. But we estimate a few hundred dollars."

"Is the stabilizer planned only for passenger-car use?"

Trucks come first. Osbon shook his head. "Commercial-vehicle negotiations are under way now. By stabilizing a truck, you prevent fragile cargo from bouncing and sliding on bumpy, winding roads. Cross-country military vehicles would also benefit. They could probably go 25 to 50 percent faster across rough terrain because of better traction and reduced personnel and load disturbances."

"When can we go to our old reliable dealer and order a stabilized passenger car?"

"Detroit is definitely interested," Osbon answered, "but we have no plans to make the stabilizer available commercially at present."

I had suspected that would be the case. The project's timing seemed wrong. Detroit's emphasis on simplicity and compactness—and the new 12,000-mile-or-one-year warranties—would have to be abandoned before a complex pile of plumbing like the Westinghouse stabilizer could be adopted.

But when they do start turning out stabilized cars, I expect to be one of the first to sign on the dotted line. ■ ■

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New Projectors Put On Whole Show

[Continued from page 74]

Why this resistance? Well, projectors aren't cheap. But neither was that automatic camera. Marketing experts claim mechanical complexity puts people off. Projectors, they say, should be as simple as aim-and-shoot cameras. If they're right, these two models should clean up.

Be a lazy host. The Carousel comes with a 12-foot remote-control cord that lets you settle comfortably with your guests. When you plug it in, you transfer the controls from the illuminated piano-key panel on the projector to a three-switch handpiece that lets you change slides (forward or reverse) and refocus (for a thinner or thicker mount).

You can set a timer on the projector, too, to change slides automatically every 5, 10, or 20 seconds. Holding down the forward or reverse button sends slides flashing past at a rate that's ideal for sequence checking or for locating a slide of special interest.

Actually, if you've indexed the load properly, you can show scattered slides from any tray. You just press a select button to spin the tray to the proper numbers, one after another, as if you were dialing a combination lock. You can show loose slides, too—the three or four Aunt Blanche enclosed in her last letter—without the tray. You just slip each slide into the gate. A tap of the button ejects it—like a pop-up toaster.

You also have pushbutton choice of light levels. The lamp projects either a 300- or a 500-watt beam. If you're using the low beam (as in a small room) you can switch to high to bring out detail in a dark slide. Or shift from high to low to compensate for overexposure.

If you're an old hand at color photography and have a massive collection of slides or movies, there's a disadvantage these projectors have in common. Designs as bold as these make previous systems obsolete. In the slide field, there's been some standardization in tray requirements for automatics. Air-equip magazines, for example, fit a number of different makes and models, so it's often possible to cart only your trays along on a visit if you check ahead and find they'll work in your host's projector. And if you shop for a new projector, you can choose from several with-

CONTINUED

Motor Trend magazine makes it official:

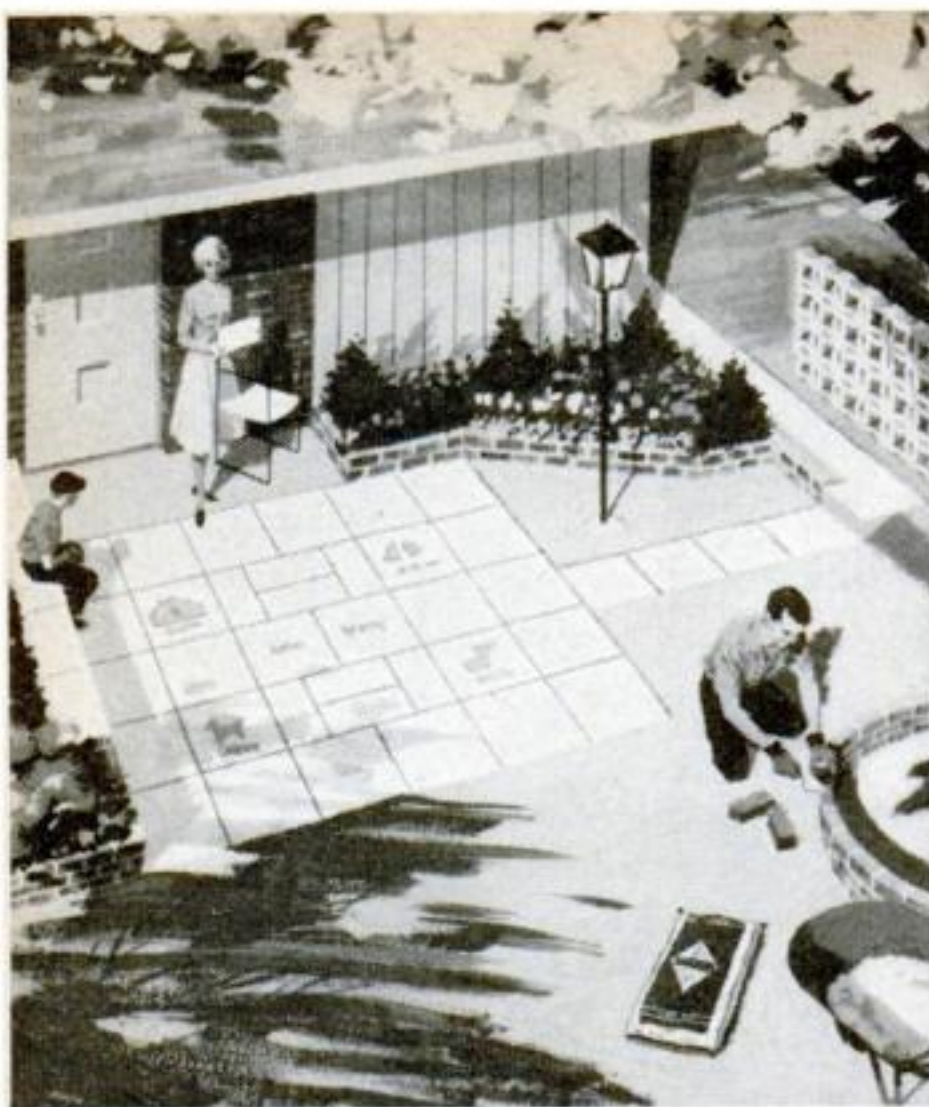
1962 car of the year!

From the very first we knew we had a winner. Happy owners, car enthusiasts raved about the 1962 Buick Special with the history-making Fireball V-6 engine. And now, the editors of Motor Trend—one of the country's top car magazines—have made it official. After road-testing and evaluating all U.S. cars, they've named the V-6 Special "Car of the Year!" Here's the way they put it . . . *"Motor Trend's CAR OF THE YEAR AWARD to the 1962 Buick for pure progress in design, originaive engineering excellence, and the power concept for the future expressed in America's only V-6 automobile engine."* Why are the car experts so hot on this exclusive Buick engine? Because only a V-6 can combine the smooth vigor of V-design with the gas savings of a straight six. Because this 135 H.P. V-6 weighs up to 140 pounds less than other sixes of comparable power. Ask your Buick dealer to let you drive a Special V-6. See how easy it is to make the "Car of the Year" your very own.

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New Projectors Put On Whole Show

out facing the prospect of refiling your old slides.

These advantages don't apply, of course, when you switch to the Carousel. Unless you want to hand-feed your old slides, one at a time, you'll have to buy enough doughnut-shaped trays (about \$3, with index cards and storage box) to hold them all. And then you'll be able to show them only on a Carousel.

Converting to the 800 involves a similar problem. Your films, again, must be fed from a special package. Here you have even less flexibility, since the system is a drastic departure from standard. Before you can project any of your old movies on the new machine, you'll have to ship them off to Technicolor to have them cartridge. If you've spliced several together, they'll be clipped back to 50-foot (4½-minute) lengths. And only films in good condition (no creases or shredded sprocket holes) can be put into cartridges.

If you're just starting out, these drawbacks aren't a consideration. However, if you're one of the rare 8-mm. fans who likes to *edit* what he shoots, you must send off exposed film for normal processing, then make your cuts and sequence switches, and finally return it for the cartridge. Technicolor is also producing color movies and cartoons you can buy to beef up home screenings. This Magi-Cartridge Library includes how-to demonstrations of such skills as cooking, gardening, and sports. The endless-loop feature might be a great advantage here: You could match golf strokes with the pro on the screen until you mastered them.

There are two features that only the 800 provides: a retractable power cord that reels itself into the case, and a socket for plugging in a table or floor lamp (when you snap the projector on, the room light goes out, comes on again when you stop the show). What can Kodak be thinking of? Not only must you coil up the Carousel's power and remote-control cords by hand (there is, at least, a storage compartment for them), but you're forced to douse your own room light! Of course, if you're burning candles, you *could* aim that powerful blower at them—just to keep things automated. ■ ■



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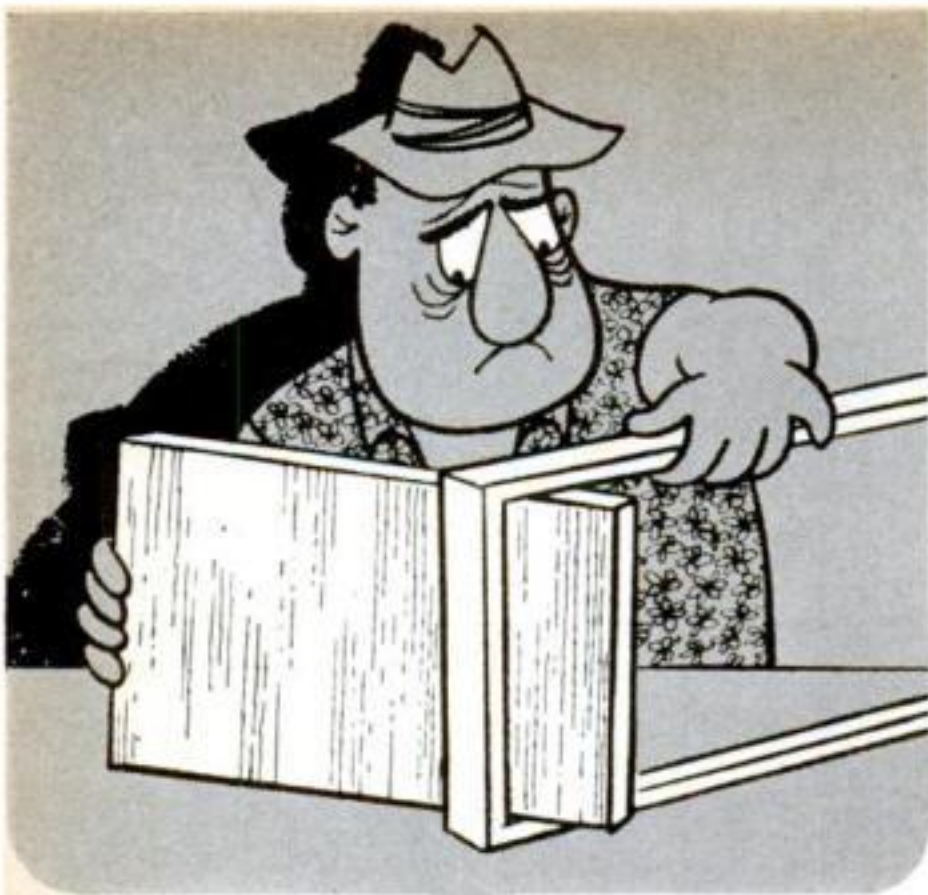
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yours at your Johnson dealer's. Look in the Yellow Pages. See Electramatic 75's and 40's (outboarding's first truly automatic transmission), the new "in-between" 28 and the famous 3. Send for free '62 catalog.

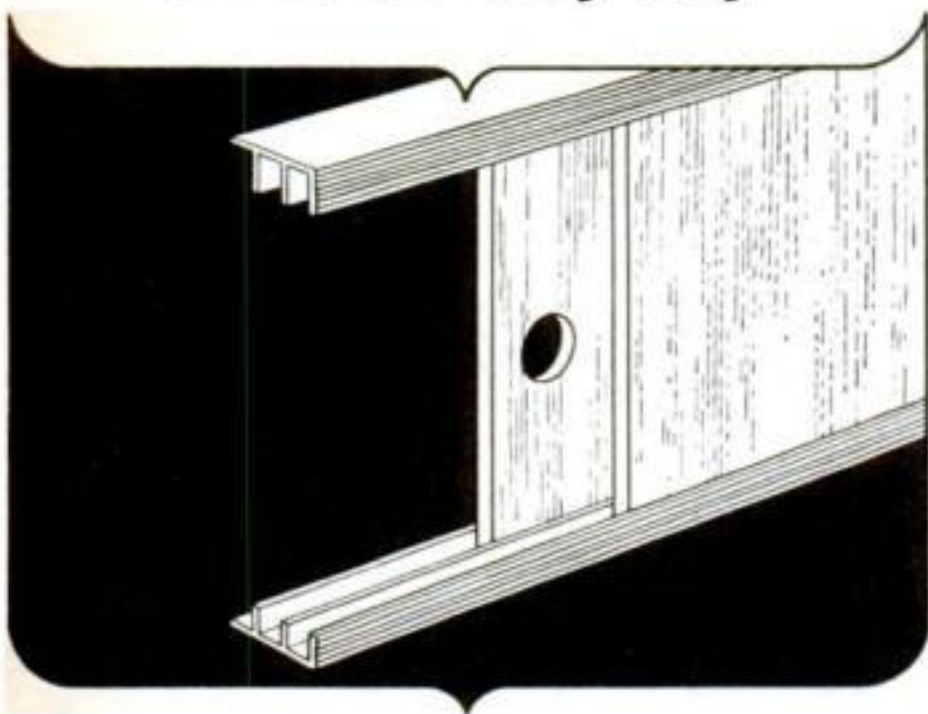
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**REYNOLDS METALS COMPANY
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How Machines Detect Phony Money

[Continued from page 69]

in 1939, Boley Andrews, now vice president in charge of research for the Vendo Company, giant vending-machine maker of Kansas City, Mo., thought of a new way to detect crooked cash. He noticed that people sometimes bounce a coin on a hard surface as a rough check of its genuineness. Each coin has a distinctive ring.

Andrews got a bagful of coins, bounced them on an anvil, recorded and analyzed the noise each made. Nickels, he found, had a clear 14,000-cycle ring. He built a rejector that bounced a nickel and picked up the ring with a small microphone. The sound was amplified and sent through a set of frequency-detecting filters.

If a strong signal came through at 14,000 c.p.s., the machine okayed the nickel. Andrews was on the verge of putting the detector into production when World War II came along. The U. S. Treasury quit making the five-cent piece of nickel and copper, turned out a new model of copper, zinc, and manganese. Unfortunately, the new coin's clink frequency was about 12,000 c.p.s.—close to that of a brass slug—so the idea had to be dropped.

It wasn't a total loss, however. Ordnance manufacturers were looking for a fast, effective way to test for defective shell casings. Andrew's bounce test was perfect for the job, and was used throughout the war.

SINCE the war, machine operators have continued to improve their slug rejectors in the face of ever trickier attempts to beat them. One flurry remembered in vending circles as the "Philadelphia Quarter Incident" came along in the late '40s. Airmen at a base near the City of Brotherly Love discovered that a penny jammed into a certain type of copper aircraft spark-plug gasket was close enough to a quarter in all properties to sneak through many rejectors.

Machine men moved in fast, uncovered two facts. First, the Philadelphia Quarter—called the Air Force Special in some sections—was slightly oversize. They tightened up the sizing mechanism on all machines. Second, its resistance—

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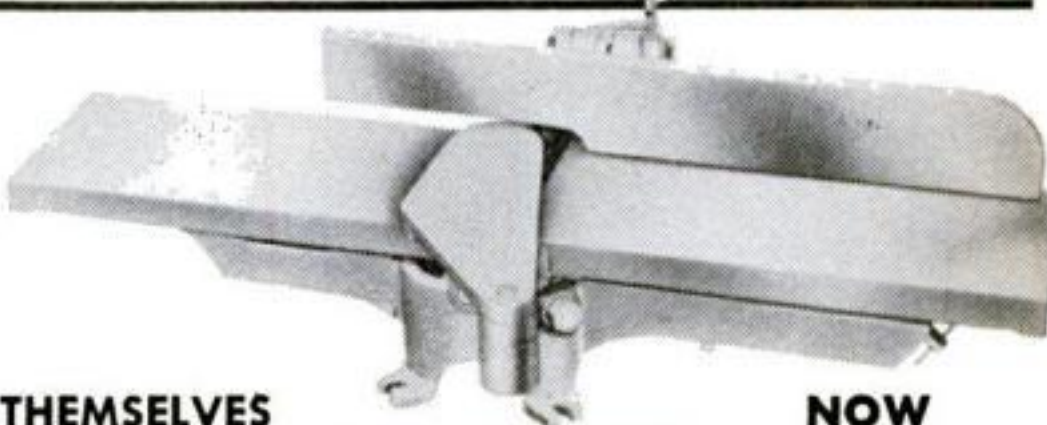
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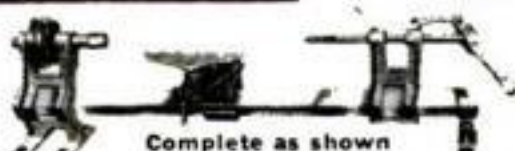
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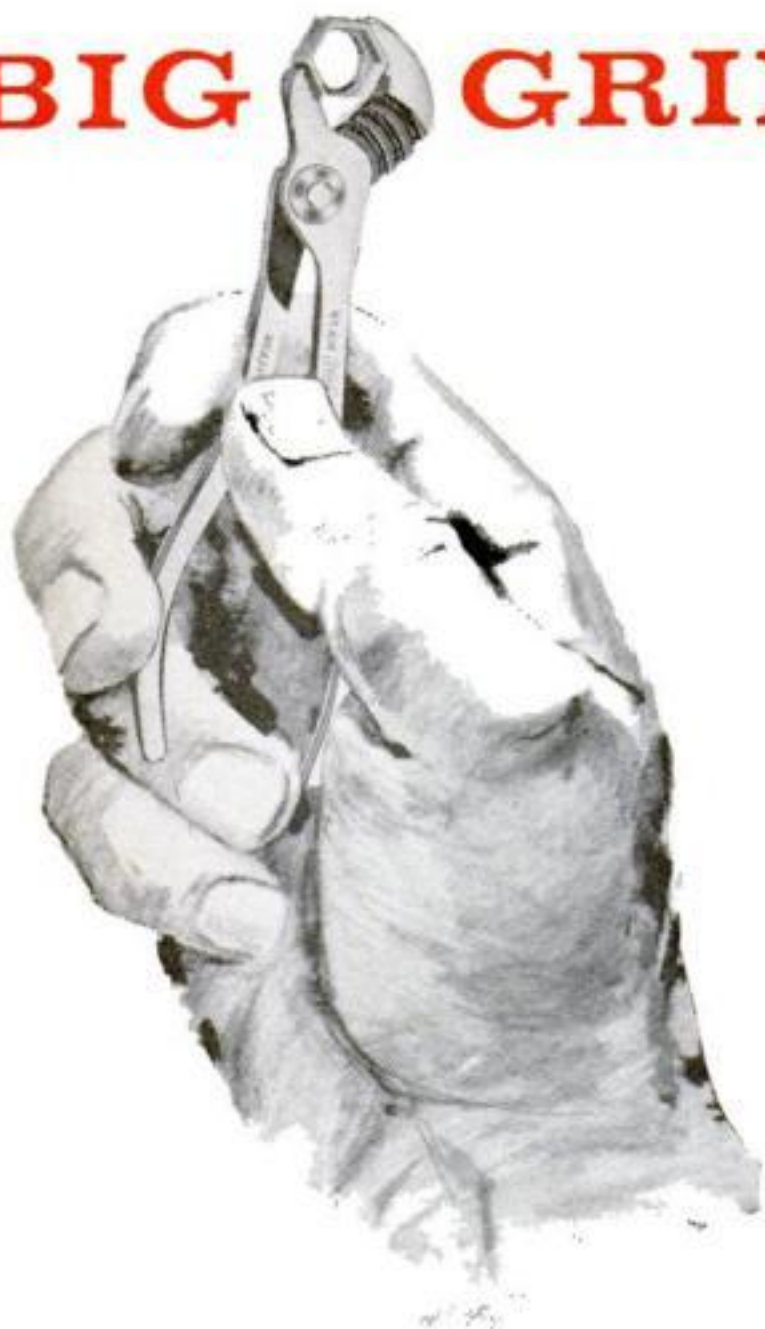
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How Machines Detect Phony Money

most vulnerable point for the slug makers—was slightly off. Engineers increased rejector-magnet strength again. The two moves solved the problem.

Today, companies are experimenting with all-electronic methods of coin testing. One firm has tried out—and found workable—a method of using a coin to be tested as one side of a thermocouple. The coin is pressed tightly against a disk of dissimilar metal and quickly heated. If the coin is genuine, the rudimentary thermocouple generates a small, but precise, voltage. An automatic measuring circuit quickly tells if the voltage is accurate, and thus reveals whether the coin is genuine.

A few years ago Vendo built a gadget that tests a coin's permeability—its ability to conduct magnetic lines of force. Vendo's experimental machine has two small sets of coils that generate a magnetic field. A sample coin, serving as a standard, is put in front of one of them, and a reading is taken of its permeability. The coin to be checked plops in front of the other coil and the two readings are compared. If they are identical, the coin is good.

The system has several advantages. Most important, it could be used without modification all over the world. Just put any coin in as a standard, and any identical coin will pass the test.

IS IT possible to make a coin that will get past the acceptor mechanisms in use these days? Certainly, if you want to go to the trouble.

Here's how you can make a phony quarter, for example:

1. Find out the exact metallic content of the genuine article.
2. Mix up an identical silver alloy.
3. Cast a slug exactly the same weight and thickness.

It will pass through the machines. If you prefer, you can start off with a chunk of the right alloy and machine it to size. Your profit won't be large, though, since it will probably take a dollar's worth of machining.

Somehow, with all the difficulties involved, and with the extremely uncooperative attitude on the part of the Feds, it seems easier to use real money. ■ ■

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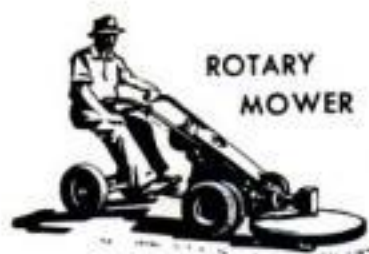
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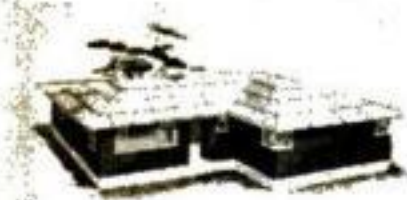


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[Continued from page 57]

he shouted up at Bill Jervis, the driver: "I've got a passenger for you."

I scrambled up the eight-foot-high fender and plumped down on it. Jervis turned halfway around and hollered, "All set?" It wouldn't have mattered. We were already plunging into the pit.

Posting violently, I resisted the temptation to grab at the knobs and levers. A few feet to the rear, a three-ton apron was beginning to rise like the curtain at the Bijou. At the same time, the front of the bowl was angling into the dirt, with 20 tons of hydraulic pressure behind it. Under its lip, boulders squealed and cracked. I learned later that the pumps used for this and other scraper chores soak up 200 horsepower. Fortunately, the rig's traction needs are lightest when those of the hydraulic system are at their peak.

Back on the haul road, with 50 tons of assorted landscape in her stomach, the 641 became a remarkably agile rig. Unlike the 666, she had a two-wheel tractor unit. Her engine was cantilevered out front. At the rear, a well-braced column acted as a hinge pin for the wishbonelike frame that straddled her bowl. To steer her, the stem of the wishbone, or gooseneck, was pushed this way or that way by a pair of husky hydraulic rams. Seated where I was, it was good to know that the giant couldn't jackknife. Those cylinders held it in a headlock, whatever the steering position. At the same time, the massive hinge post was free to rock from side to side. This was what kept all four of the outfit's wheels planted firmly on the ground, regardless of road irregularities. The axles of tractor scrapers are not sprung; only the tires absorb road shocks.

Halfway across the dam's broad back, Jervis pinched the 641 down to 10 miles an hour. Then he hoisted the apron with one lever, and triggered the bowl ejector with the other.

At the end of the pass, he made a U-turn in four-fifths of the scraper's length. Nudging his gear stick to neutral, he signaled me to watch him run through an upshift.

I guessed what was coming. When we got back to the borrow pit, he didn't turn into it. Instead, he pulled onto a



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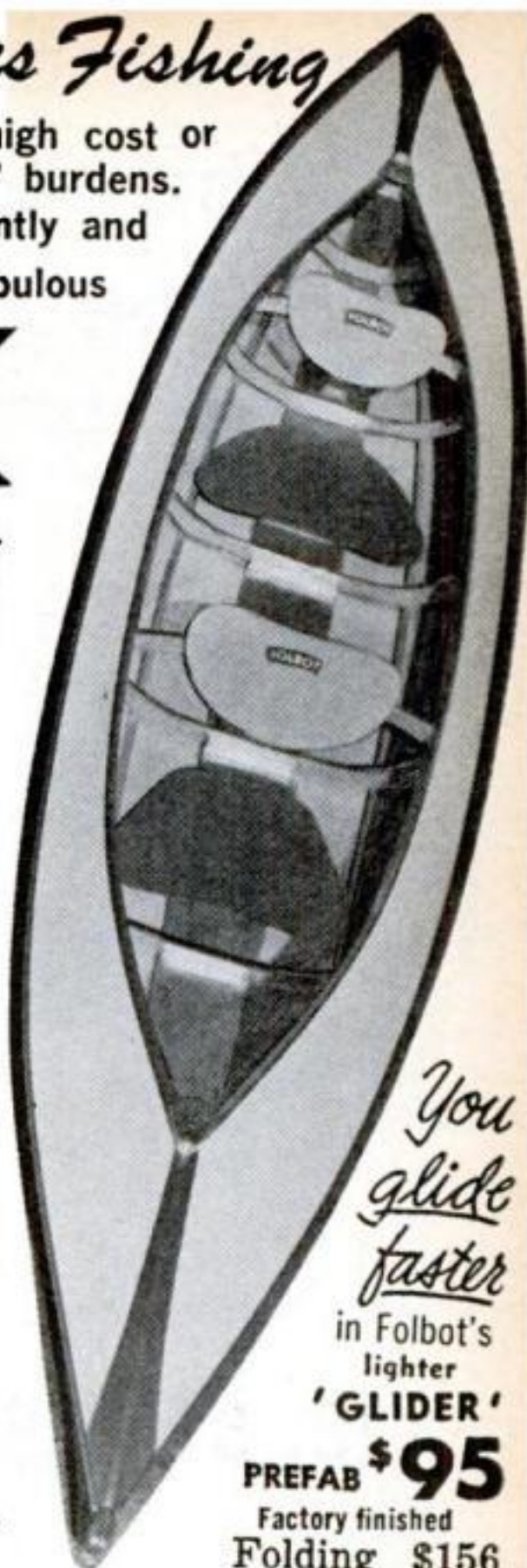


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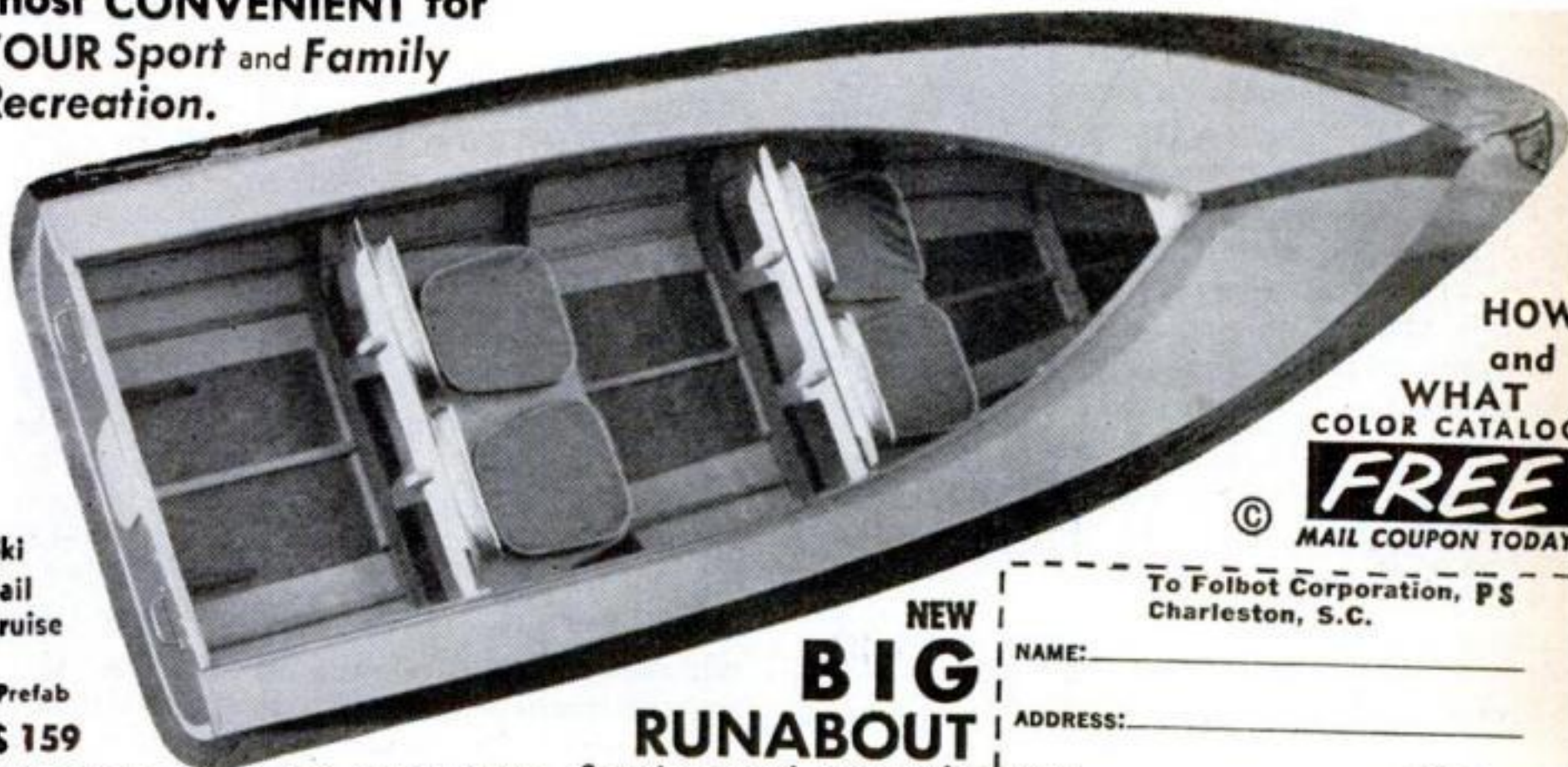
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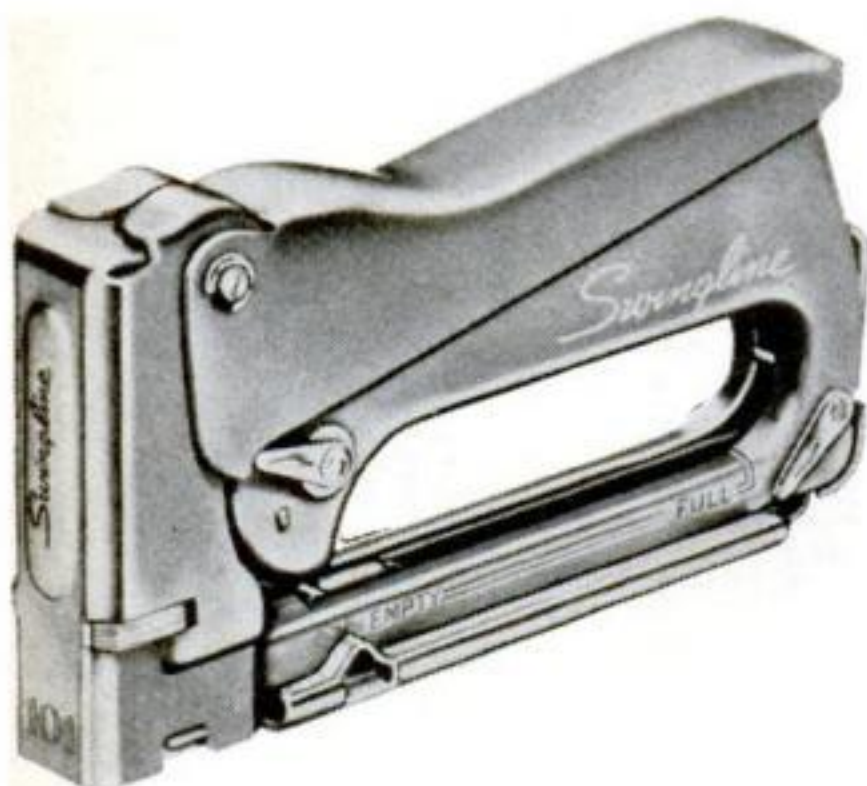
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stretch of haul road, stopped, and climbed off the seat. "You take her," he said, and dropped to the ground.

Behind the driver's wheel. Not since my granddad told me I could run his spanking-new Holt Caterpillar, back in 1922, have I approached a set of controls with such awe. I slipped into the bucket seat, cushioned with adjustable rubber torsion springs and a shock absorber. Underfoot were only two pedals—a service brake and a throttle. Beside my right knee a trim little lever projected from a box. You shoved it forward for reverse, or pulled it straight back for three progressive manual upshifts. On the dash, a tachometerlike indicator gave the cues.

I eased the lever into Number 1 notch, tromped on the accelerator, and took off. There were three distinct upsurges before the indicator needle climbed into the striped green area that told me I could advance the stick another notch. The same thing happened in second and third.

A combination of manual and automatic, this Caterpillar transmission actually takes you through nine forward speeds. First in each hand-shifted range is a flexible torque-divider drive. Then, as the engine revs up, you go successively into direct drive and overdrive. Company engineers admit that a sharp operator can do as well with a six-speed direct-drive transmission—for an hour or two. But in a work day, fatigue takes a toll of human reflexes. That's where the power shift pays off.

When I kicked down through the manual ranges at the end of the haul road, the 641 bucked in mild protest. *Next time, punch the throttle*, I told myself. The brake action was surprisingly smooth, and cranking for the turn took no more effort than getting my 1952 DeSoto around the village square. Accumulating confidence, I poured it on, going back. Bringing the monster to a sedate stop at the pit, I was about to drop to the ground when I discovered that even on a slight slope, the 641 wanted to roll on her own.

"Where's the parking brake?" I shouted. Jervis pointed up at one of the scraper controls. I pushed the lever in-board until the bowl dipped gently into

CONTINUED

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Dirt built to scale. Back in Peoria, I spent a day watching the kind of advanced spadework that's gone into the 10 new scrapers. I saw hydraulic equipment flexing its muscles in a cold room where the mercury barely climbed above the thermometer bulb. I listened to the drumming of a big diesel V-8, and followed the twitchings of automatic pens jotting down reports of the block test. In a soil-dynamics lab, engineers placed a one-tenth scale model of the 666's bowl on a trolleylike carriage and ran it through a king-size planter box filled, not with earth, but a mix of fire clay, sand, and oil. Scientifically compacted, the material simulated dirt of any type, miniaturized to the same scale as the scoop. Stress gauges registered the amount of thrust needed for loading.

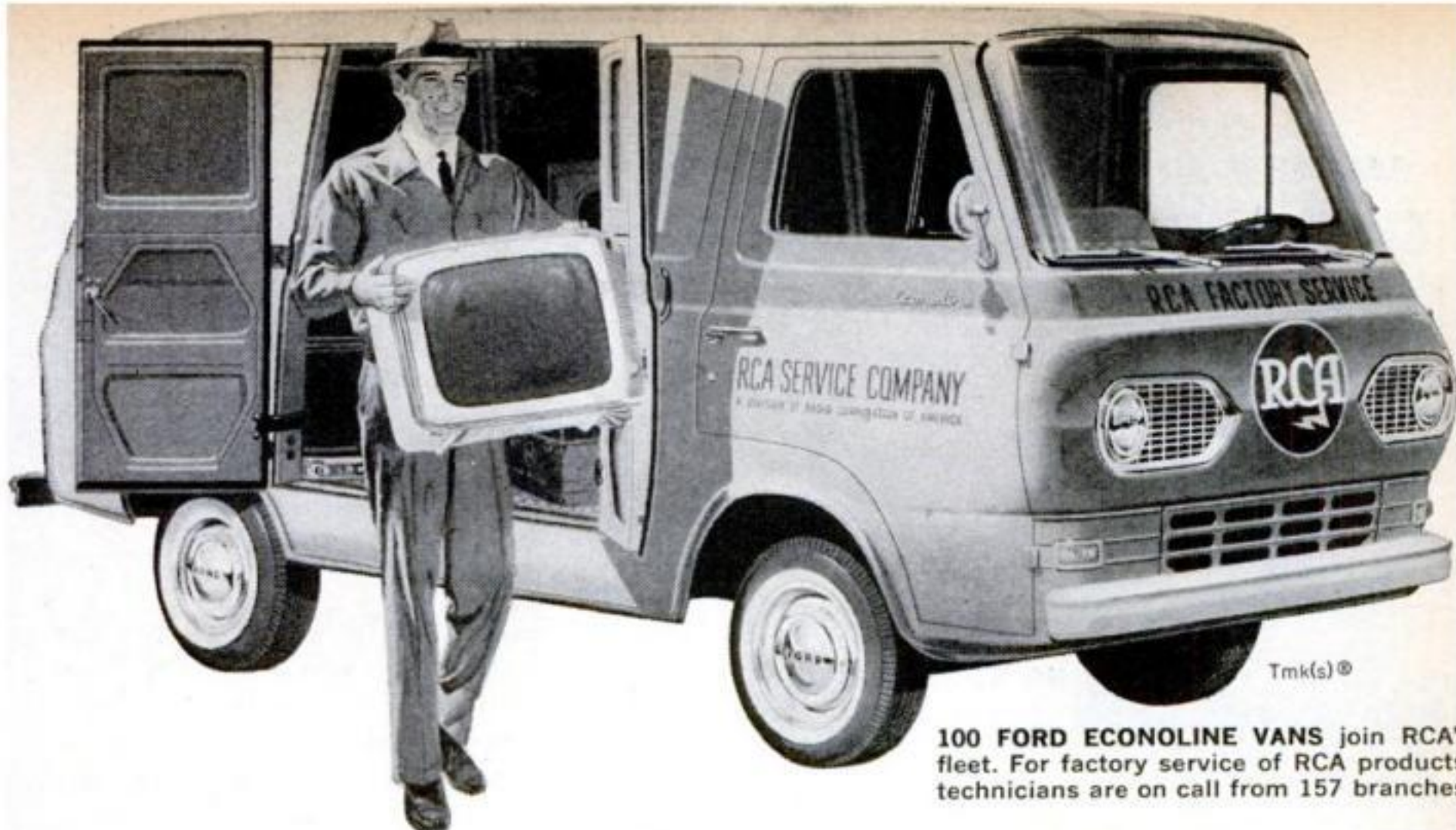
Finally, I went out for a turn around the proving ground where the 666 and a couple of lesser scrapers were crouching like enormous yellow grasshoppers.

Three Cat officials were admiring the beasts. "There's just one question left," I said. "How do you justify two pushers helping an allegedly self-propelled shovel through a borrow pit?"

"That's one for the customers—not us," Gardner Hatch laughed. "Any scraper can pick up its load without an assist. But I'd be willing to bet that the first man who ever bought one welded a push block behind it and gave it a shove with another rig—just to save 20 seconds. Naturally, it wouldn't make sense to use two \$60,000 D9s with one \$110,000 outfit like the 666. But when you're running a fleet of scrapers, you spread the pusher cost thin. Those 20 seconds can make the difference between breaking even on a job and showing a profit."

"There's another angle," Robert Morrill cut in. "You need from one to two times more power for fast shoveling than for getting over the road. So the right place to keep those extra horses is in the pit."

Dale Turnbull wrapped it up. "The fact is that the contractor is the final engineer. But right now we're ready to offer him a litter of Cats that should meet his maximum needs for several years to come."



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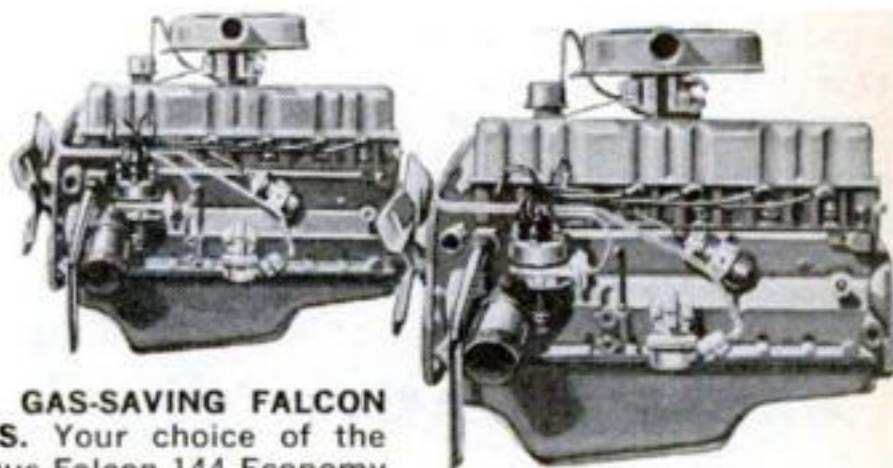
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[Continued from page 99]



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samples of the moon's crust. These may be analyzed automatically by a little lab inside the globe—or stuffed into a small rocket and shot back to earth, whence the launching command would come.

Besides making all observations needed to choose a favorable site for a manned landing, large rovers will do such useful jobs as installing landing beacons. Since these vehicles could be equipped to be run either by remote control or by a man in a driver's seat, they could later be used by the landing party itself.

Getting power. Most of the moon-car designs convert the sun's energy into electricity with solar cells. Some of the largest cars draw power from fuel cells, or from an atomic generator, using the heat of radioactive isotopes.

Nobody expects moon cars to be raceabouts. Typical top speeds are the less-than-dizzy ones of three m.p.h. for Space-General's six-legger, and five m.p.h. for NAA's wheeled truck. No asset, greater speed would only aggravate the problem of control from earth, which will be formidable enough as it is.

Steering any of these vehicles will be the eeriest kind of back-seat driving—across 250,000 miles of space. A TV camera on the lunar vehicle will show the earthbound operator where it's heading, and he'll radio steering commands.

To keep a moon vehicle from blundering into an obstacle or over a cliff, an operator must act well in advance—because of unavoidable delays in transmission. It takes radio signals 1.3 seconds to travel each way, between moon and earth. And, to conserve power, moon cars' TV cameras will doubtless be slow scanners—providing a picture only every one to three seconds. So the operator's TV screen will show only where a moving vehicle *was*, several seconds earlier. To avert accidents it must move slowly and stop often.

Eyes on the moon. The lunar vehicles' TV cameras almost certainly will need to be equipped with binocular lenses for depth perception. Another necessary refinement will be some sort of flash equipment on the vehicle to illuminate shadows. On the airless moon, there's no natural scattering of light, so objects

Weird Robots to Explore the Moon

in shadow will be as dark as at night. Space-General engineers foresee, too, that their little walker might stroll behind an obstacle and lose contact with earth. They propose equipping it to go automatically into reverse if this happens—and back up until it's once more in touch with its operator.

Right now, the moon-vehicle command center could be set up at the Goldstone, Calif., desert site of Jet Propulsion Laboratory's deep-space communications station. But the moon is visible only eight to ten hours daily, from any one point on earth. With the help of similar stations soon to be in operation at Johannesburg, South Africa, and Woomera, Australia, command of a lunar car can be passed from one station to the next—around the world and around the clock.

What's it like up there? Designers of lunar vehicles face the fact that little is known about conditions on the moon. That much is far from encouraging.

Since the moon's temperature ranges from about 235 degrees F. in full sunlight down to 245 below zero in darkness, some way must be found to keep vehicles from freezing in the lunar night.

The moon's "atmosphere" is a high vacuum—and, in a vacuum, solids tend to stick together. Will adhering sand or rock dust clog a rover's running gear?

And will corrosive chemicals attack it? Lunar rocks may be highly active chemically, warns Dr. Harold C. Urey. (Analyzing samples will tell.)

On the plus side, however, vehicles will weigh only a sixth as much as on earth. And, without air, there can be no winds or storms.

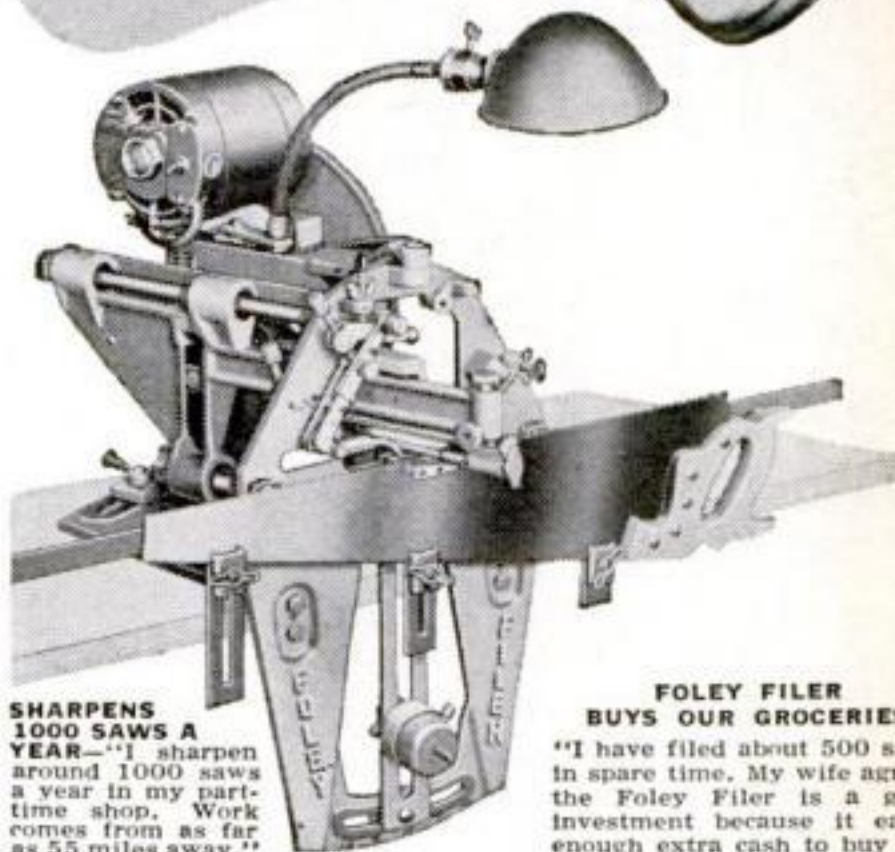
The big "unknown" is what the moon's surface is like. Once, most of it was supposed to be jagged and forbidding. Now scientists think its major part is smooth (highest obstacles, four inches) and undulating (steepest slopes, 15 degrees)—perhaps much like the Sahara Desert. Sand or dust a quarter-inch to four inches thick, they believe, covers a solid layer of unknown composition.

That's the present opinion—but nobody knows for sure. Finding out will be the first moon cars' job. Then designers will know better how to build the others that will follow. ■ ■

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17-Mile Highway Over and Under Sea

[Continued from page 93]

and involved no tunnels. A nearer match in all but size was Virginia's own three-mile Hampton Roads Bridge-Tunnel, opened in 1957—almost a miniature model of the new one.

Three modern advances are largely responsible for making the dream of the Chesapeake Bay crossing come true, say its engineers: trench-type tunnels, piles spun to shape—and prestressed concrete, first used in large structures only a dozen years ago.

"Elastic" concrete. The Chesapeake Bay project ranks as one of the biggest applications to date of this "concrete with muscles." Wires stretched with jacks, and then permanently bonded to the concrete, transform it from an easily pulled-apart material to an elastic and strong one—ideal for the piles and deck slabs of the new trestle. Both are being fashioned of prestressed concrete at a \$3,500,000 casting yard, newly built for the purpose on the bay's north shore.

On the way to the casting yard, we rode the state-operated ferry—the present leisurely way of crossing the bay. It's a sail of an hour and 25 minutes. Drivers bettering 40 m.p.h. on the new sea highway will take just an hour less, and will be spared an average half-hour wait for a ferry to leave—which adds up to the estimated 1½-hour time saving. Ferry fare for a car and driver is \$3.83; the planned highway toll will be \$4.

Designed not only for people in a hurry, the Chesapeake Bay Bridge-Tunnel will offer motorists pleasant ways to spend the time they've saved. Tourists may enjoy dining and dancing in a glass-walled restaurant, on the southernmost artificial island, commanding a panoramic view of the bay. And at least one man-made island will have facilities for fishing, with rockfish and flounder a likely catch. Consulted by the bridge-tunnel's planners, Virginia's Bureau of Fisheries has recommended each channel's north island for this purpose.

That is a preview of Virginia's great 17-mile highway over the sea. Today its massive trestle, undisturbed as yet by traffic, provides a made-to-order roosting place for hundreds of plump gray sea-gulls—a sight that serves to emphasize its oceanic setting.

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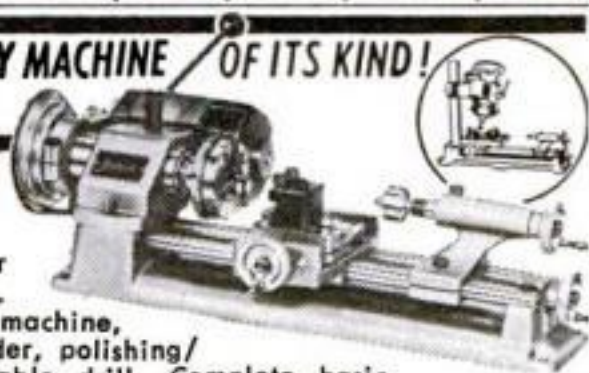
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knows how to write the program). It would be taught like a human, with "rewards" for the right answers and "punishments" for the wrong ones.

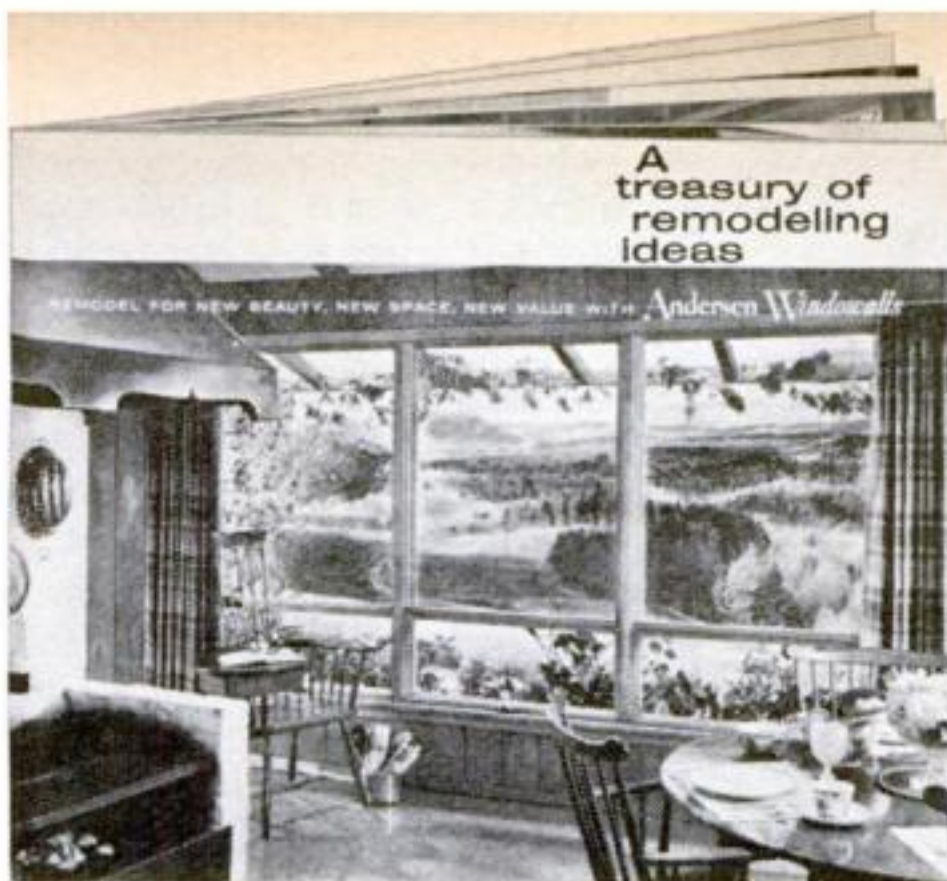
Even such an eerily human machine as that, however, cannot cure Project Z's main handicap. Relying on sound created by the intruder is okay so long as you're listening for clanking diesels kicking up surface wakes. Atomic submarines, under water, make no waves. Their reactors are silent, and their turbines can be shushed with vibration-damping mountings. The Navy is also close to a thermoelectric engine, which would convert atomic heat directly into electricity—no moving parts. That would leave only an electric motor, which can be very quiet.

Nobody gives the Russians lessons on vibration mountings or thermoelectricity. While their present subs may be noisy as Khrushchev, new models could be as silent as a Stalinist sneaking past border guards.

Sound-wave radar. If the intruder makes no sounds of its own, the defense system has to provide some. You send out a beam of sound waves and listen for the echoes—the same as radar but with sound waves in water instead of radio waves in air. This is sonar, an old idea invented for World War I and widely used in WW II. The U.S. fleet is now equipped with sonars that can "see" underwater objects 10 miles and more away. This works fine for patrolling limited areas—the Russian submarine exit from the Norwegian Sea, for instance—but it can't cover thousands of miles of coast.

The way to increase sonar range is to make the sonar bigger—more power and longer wavelength. Prof. Frederick V. Hunt, Harvard's acoustical expert, convinced the Navy to go whole hog: Try out not just big sonars, but tremendous ones that might flood entire oceans with sub-detecting sound waves. Project Artemis is the result. (The code designation is an inside joke—Artemis is the Greek goddess of the hunt.)

The test now under way uses a sound generator 50 feet long. It is made up of a number of small units. These generators probably work like radio loudspeakers: electromagnetic coils vibrating dia-



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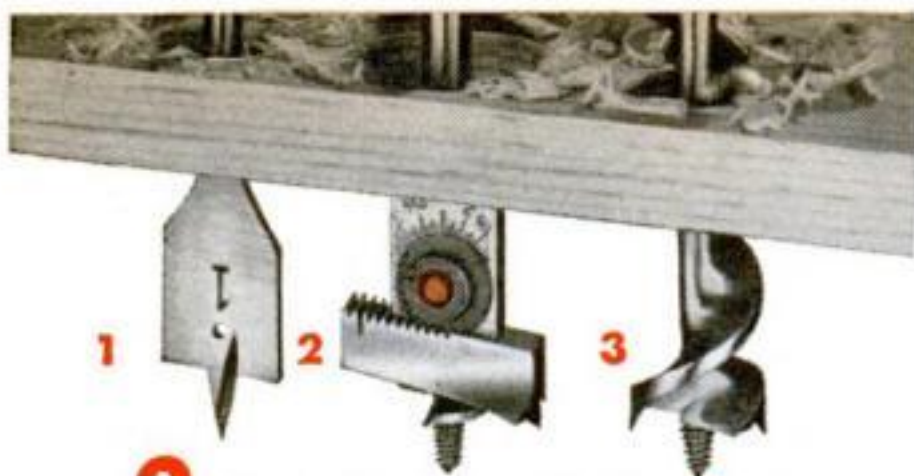
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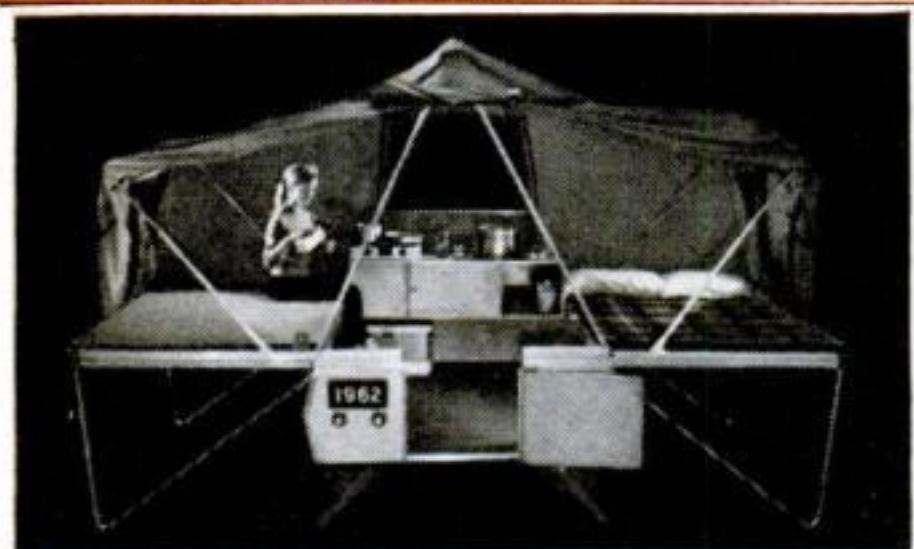
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This monster of a loudspeaker is only the sound projector; it does not listen. The echoes are picked up by a separate set of ultrasensitive hydrophones, which feed the signals to a Texas Tower, called Argus Island, on an extinct underwater volcano southwest of Bermuda. Argus Island relays the signals to Bermuda, where a large and sophisticated computer calculates whether the echo came from a sub or a whale.

Flip and Spar. For the test, the sound projector is carried on a ship—an old Navy tanker named Mission Capistrano—so that different setups can be tried. In a full-scale, permanent system, the huge noisemakers could be mounted on Texas Towers or, more likely, on man-made floating islands. The Navy is already building a couple of these king-size buoys—Flip and Spar—for “oceanographic research” (a euphemism that most often means antisubmarine work). If the reported range of Artemis—100 miles plus—is correct, a few dozen such installations would cover both Atlantic and Pacific coasts. The hydrophone network for picking up echoes might involve only a remodeling job on Project Z.

The Navy has not yet decided to go all out with Project Artemis. Many of the Pentagon brass are leery of any Maginot Line idea, since it involves a fantastic investment in a single system that might easily be outflanked. They worry more about the menace to our supply routes from the Russian's present sub fleet—obsolescent but powerful.

Other sub-spotting techniques are being pushed hard. Some scientists still hope to find a “window” in sea water that will let radar waves through. Infrared is promising—a submarine propeller, even when way down, stirs up the water so much that the sea surface above warms up. The temperature change is very small (less than .2 degree F.), but airplane-mounted detectors can spot it.

Yet all this effort is dyed gray with pessimism. Ask any antisubmarine researcher how it goes and you get a stock answer: “I'd bet on the submarine.” ■ ■

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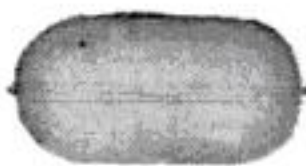
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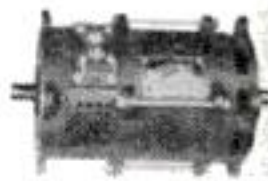
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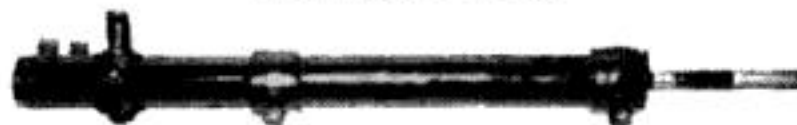
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Engineering Behind the '62 Outboards

[Continued from page 116]

carburetor. Quick couplings make it easy to shift on the run from empty to full tank.

Fixed-jet carburetors now bypass an always touchy adjustment. Automatic chokes seem to have brains of their own. Some open partially the instant the engine catches, but rechoke if it stalls. Or, if you over-ride the automatic by closing the manual choke and forget to open it once the engine starts, the automatic remembers for you. Most engines have throttle and spark synchronized to provide correct spark advance at any speed.

How much oil? Scott alone specifies 1 part oil to 40 of gas; others recommend a 1:24 mix. Scott's tests with a 1:100 mix of oil having a polysulfide additive make McCulloch engineers wonder whether this, rather than the oil, doesn't lubricate the engine. Dr. Millar sees a possibility of lubricating pills in gas-soluble envelopes. Drop one in the tank for each gallon of fuel, and your outboard would be lubricated by the resulting "slippery gasoline."

Meanwhile, Scott offers an optional lube system for 1962. A metering pump linked to the throttle injects oil from a separate tank into the gas line. Other makes have similar rigs ready.

Killing off the noise. Quieting the outboard began when somebody dropped a hose from the exhaust into the water. One answer to the resulting back pressure on starting is a bypass. Empty at first, it lets some exhaust directly into the air. Once the engine starts and cooling water circulates, it fills the bypass to route all the exhaust underwater.

Chambering and "tuning" of the passageways now make some of the racket battle itself and so cancel out. Back pressure is cut by exhausting into prop suction—and prop efficiency improves, too.

Some of the noise is directly airborne, some amplified by the vibration of "talking surfaces" such as the transom. Cloak-and-dagger operations during World War II gave Bob Carney, an Outboard Marine engineer, the job of hushing outboards for secret landings.

Taking a cue from Hollywood sound stages, he built a hood like that used to muffle camera noises. Lined with fibrous

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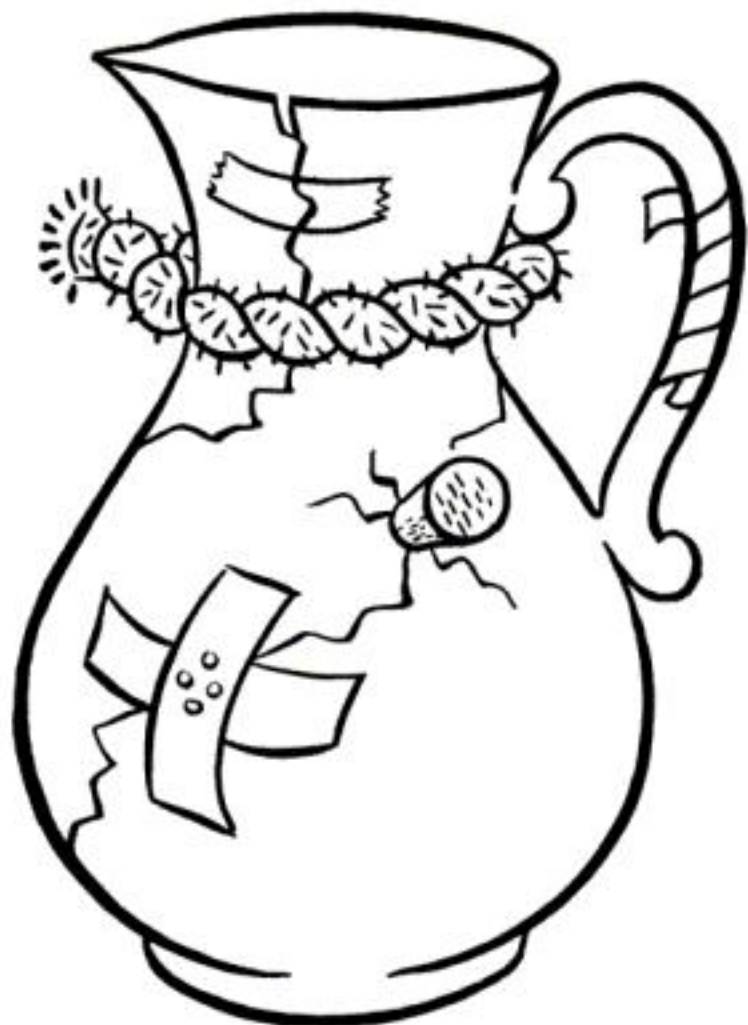
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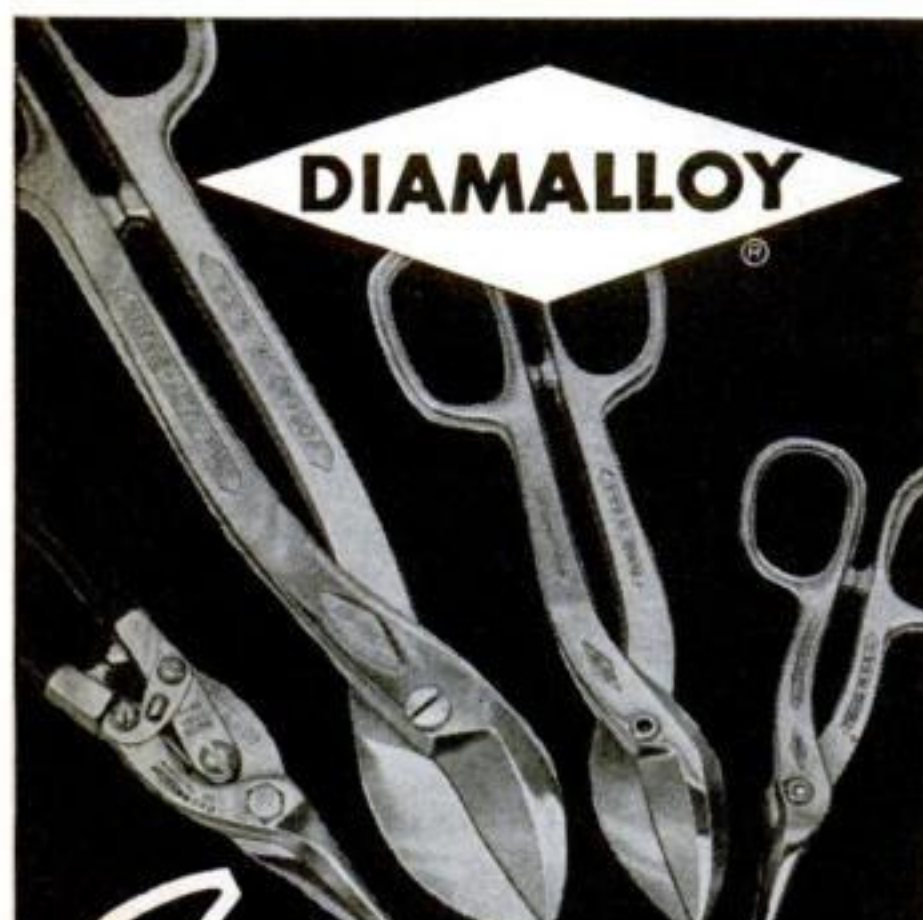


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Engineering Behind the '62 Outboards

material, such hoods kept enemy sentries from hearing boat motors. Similar ones, on some engines sealed to an underpan with rubber gaskets, now bottle up engine and air-intake noise.

Hull-transmitted vibration noise was tackled by floating the engine and lower unit on the transom bracket in nylon or rubber mounts. Now you can talk in an outboard-powered boat without yelling—hull surfaces no longer talk back.

Engines start in neutral nowadays—you no longer take off like a scared water bug the moment they catch. The drive-shaft gear turns two free ones on the prop shaft in opposite directions. A sliding dog clutch, keyed to the prop shaft, turns only when moved to engage one gear or the other.

Shifts, shear pins, and shocks. At Outboard Marine's training school in Milwaukee, I saw a cutaway of the new electric shift on 40- and 75-hp. Johnson and Evinrude outboards. It has an elegantly ingenious torsion clutch for each driven gear—a helical spring keyed to the gear and turning with it on a hub splined to the prop shaft. When a stationary ring-shaped magnet is energized, it wraps the spring around the hub, solidly transmitting torque. The action is so quick I couldn't see it happen.

Hitting submerged solids used to mean a snapped shear pin at least, sometimes a broken shaft instead. Mercury introduced a safety clutch in 1946 that proved such a good idea it's now pretty general. A neoprene sleeve is squeezed between the shaft and prop hub. If the propeller hits anything hard enough to stop it, the smooth shaft twist-slips inside the rubber. The shear, or inside twist of the sleeve, takes up some starting shock, too.

The tilt is tamed; shift into reverse and it's locked out so that you can't dump the motor into the boat by hard backing. Shock absorbers soak up the bump when a motor slams down after riding over an obstacle. Some outboards even have a mercury switch that cuts the ignition to keep the prop from screaming while it bites thin air.

All in all, when you look over the new crop of what used to be called putt-putts, you'll find that you can toss out the salty vocabulary along with the old starting rope. ■ ■

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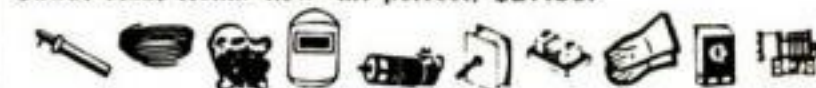


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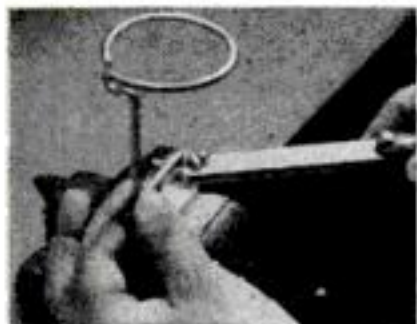
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[Continued from page 119]

cruiser, but abandoned it when the motor stopped. They'd failed to notice a closed valve under the deck. Even if they'd found this valve, they probably would have missed another neatly concealed in a dark recess.

- Hidden short-out switches can be tucked away inside the casing of an out-board that has no external wiring. (Some owners also install dummy spark plugs, nipping off the side electrodes.)

- Strong motor locks and chains are a must. Avoid using soft garden-swing chain; anchor your motor to your boat with hardened quarter-inch chain—the kind sold for bikes and cased in plastic. Padlock it to a strong hasp, not screwed on but bolted clear through the transom. Trim the bolt off 1/10 inch behind the nut and rivet it over with a ball-peen hammer. This combination will defeat almost any thief.

- Paint a mark in fluorescent paint somewhere on hull, deck, or cabin top. A stolen boat is hard to spot from search craft or planes, says the Coast Guard. An identifying color or design helps.

- Carve or burn your initials into the boat in two unlikely places—so you can prove ownership if necessary. And know identifying details. One man got his boat back because he remembered a knothole under the stern seat.

- Leave your name and phone number in the boat to help the Coast Guard or police if they find it abandoned (as often happens).

- If there is no police patrol in your harbor, organize a volunteer patrol.

- Know your motor number. If your motor is stolen, notify not only the police but the manufacturer at once.

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Finally, if you install protective gimmicks, don't forget them—when you start a trip. One Chicago owner, robbed four times, recently did. He climbed into his boat, heard a loud click, felt an agonizing pain. He'd stepped into an animal trap he'd put there to foil thieves. ■■

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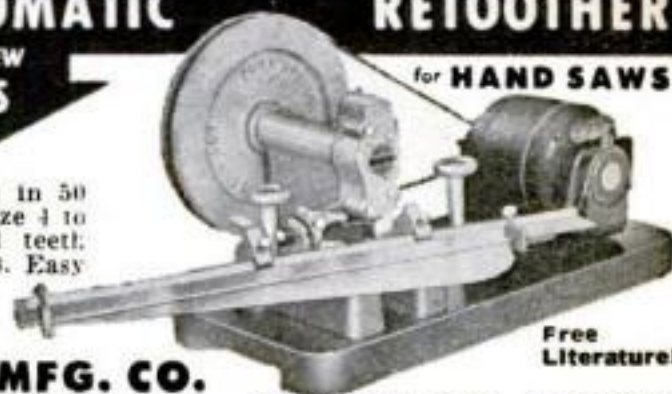
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The Big Boom in Sailboarding

[Continued from page 142]

besides speed, is an almost complete lack of maintenance. The fiber-glass models require no painting, scraping, calking, or other seasonal care. They're also so tough and forgiving that beginners have slammed them into docks and right up onto dry beaches without a scratch.

Plywood hulls are perfectly good, but will require somewhat more tenderness. Solid molded-foam sailboards—not to be confused with the hollow fiber-glass ones—have had an up-and-down record. Some early models were covered with speed-killing "warts" caused by vents in the molds. Others were soft enough to dent with an elbow, or succumbed sadly to the dissolving effects of gasoline from nearby motorboats. Bear this in mind to avoid getting one of these early lemons if you consider buying a secondhand sailboard. Most new hulls today are either plywood or fiber-glass.

Nylon sails are worth the slight extra expense over cotton because they end the problem of rot and mildew. They're also lighter and shed water quickly when you want to make a fast recovery from an unplanned spill.

Be sure of your payload. The number of persons that a sailboard will safely carry is fairly critical and depends on size and design. You should be sure to get one that will lug the load you plan to put on it. Generally, the shorter sailboards in the \$200-or-under class will take a total crew load of about 300 pounds—good for two slim adults or one husky and a small fry. They have the advantage of being light, easy to launch, and easy to right if a youngster goes over alone. For a pair of hefty grownups, pick a 400- to 500-pound-capacity hull, usually in the \$375 to \$475 range.

While most sailboards are sharp-pointed, you'll find a few blunt-nosed ones reminiscent of the old inland racing scows. They're fast, although they may not look it. One of these is the Snark, made by Alcourt's closest competitor, Royalty Sports of Utica, N. Y. Rudders and daggerboards may be of either mahogany or fiber-glass. Both are smooth, fast, and practically unbreakable. Fiber-glass, however, has one unfortunate fault—it will sink if you drop it overboard; mahogany won't. ■ ■

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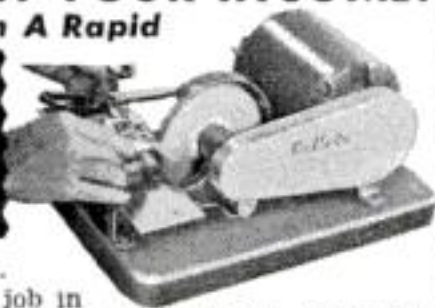
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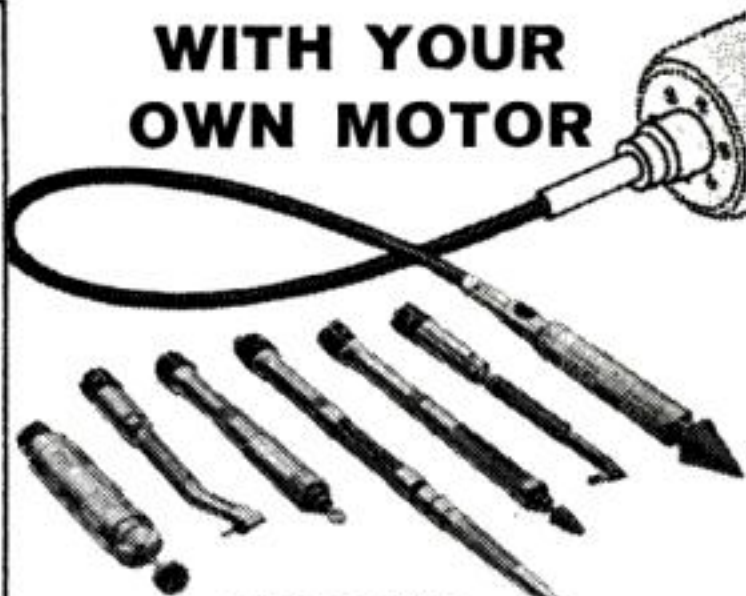
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Wood Bargains from Country Sawmills

[Continued from page 148]

One summer for soft woods, two summers for hardwoods. (Winter-drying is slight.) You can cut seasoning time by stacking the green lumber in a hot, ventilated attic.

Rough-sawn or dressed? Sawmill lumber dressed on two sides generally sells for about two cents more per board foot than rough-sawn material, though the rough-sawn texture leads for vertical siding that will be stained. Save by using rough lumber for rough jobs like shoring and cement-form work.

If you need dressed lumber in quantity but you buy from a mill not equipped for the work, you can have the dressing done elsewhere or do it yourself with a rented floor sander. You still have a bargain.

If any boards are cupped, lay them convex side up in the sun to flatten—an hour or two may do it. Then set all stock on a level floor, edge to edge, and proceed with the same method and abrasive grades as in floor sanding. You can do about 100 square feet an hour. The advantage of dressing with a floor sander: For wall paneling, doors, and table tops, you can smooth material much too wide for a conventional planer. Advantage of the planer: close control of lumber thickness, as for precision cabinet-work.

About seasoning. Wood strength increases with seasoning. When moisture content drops to an air-dried normal of 12 percent endwise, compressive strength is double that of green wood; at a kiln-dried 5 percent, it's almost triple. But seasoning also cuts flexibility and shock resistance sharply; a seasoned telephone pole snaps off when an automobile hits it; a green tree of equal diameter demolishes the auto.

Shrinkage that accompanies seasoning is greater in hardwoods than softwoods, about three times more in true hickory than white cedar, and always greater across the grain than lengthwise.

Nails hold as well in green wood as in seasoned wood, though the holding power of some species drops when it seasons with the nail in it. Use spiral-grooved, barbed, or screw nails to retain full holding power from green to air-dried in any wood.



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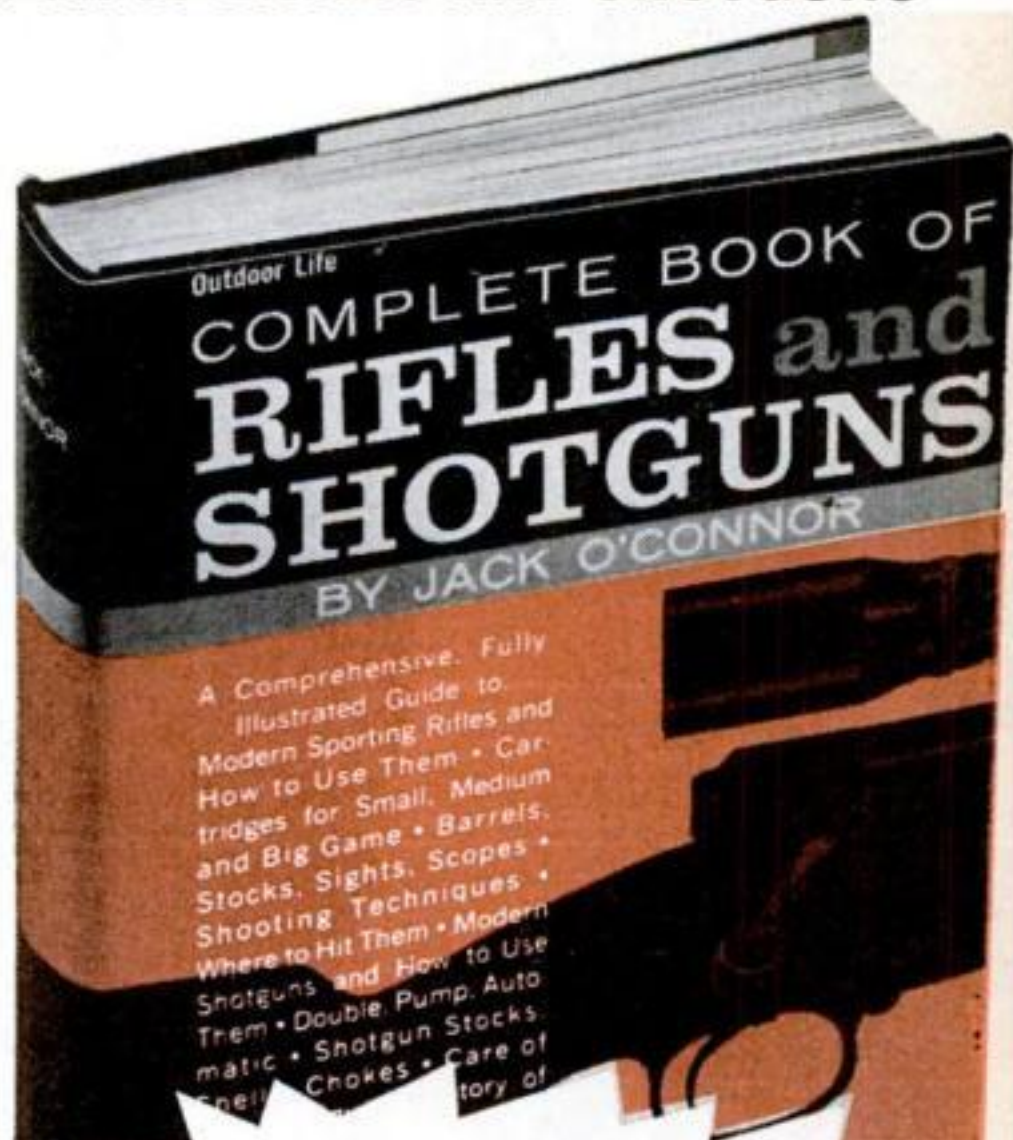
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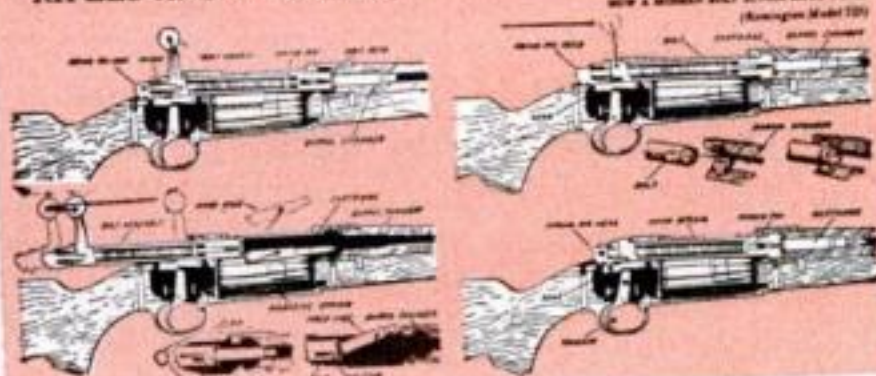
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MONEY BACK GUARANTEE

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Fixing TV's Dead Heats

[Continued from page 151]

and *whew*—the connection opened up.

Looking closely with a flashlight, I saw corrosion down inside the pin hole.

I cleaned the socket well with solvent and a needle, put in a new tube, and kept my fingers crossed for the next 10 minutes while the set operated. No more trouble. I said, "Okay, Pete, there's your problem child. Lively as ever."

Grinning, Pete said, "I knew what was wrong all the time. In fact, I told Mom."

I gave him my dirtiest look.

"No kidding, Art. I couldn't let Mom know I couldn't fix it—so I told her I was bringing it in for a good cleaning."

The Case of Some Light

I DID a double-take when a monstrous console TV came floating toward my shop window. A tiny Italian car was backing up to the door with the TV strapped to the rear bumper.

When I went out to help bring it in, the customer said knowingly, "It's nothing simple like a tube. I've tested them."

"Let's have a look, anyway," I said.

I turned on the set. No sound, no pix. I looked inside. Four tubes were lit and the rest were dead. It was a series string. How could only four tubes be lit? Looking closely, I saw these were overly bright. I switched the set off quickly to avoid burning them out.

The tube-location guide pasted inside the cabinet showed me that the heater path started at a series-dropping resistor, then went to a 12DQ6, to a 12AX4, a 10DE7, and from there to a 5U8. These were the four lighted tubes. This meant that the heater voltage path was somehow shorting out to the other side of the line at the 5U8. The full line voltage was applied across the four tubes and the resistor.

I put the 5U8 in the tube tester. It showed a short between heater and cathode inside the tube. Since the cathode of the tube was grounded in this circuit, the heater voltage was being shunted to ground through the tube. I put in a new 5U8 and the trouble was fixed.

"I didn't see any point in testing the lighted tubes," the customer said unhappily. "Testing only the dead ones sure seemed logical to me." ■ ■

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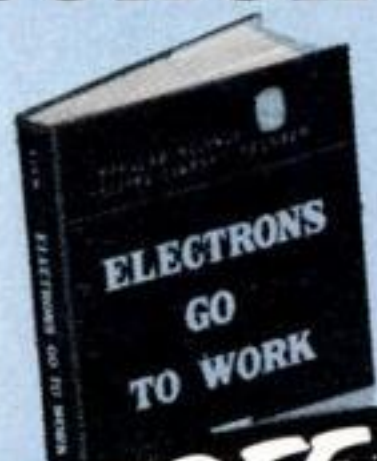
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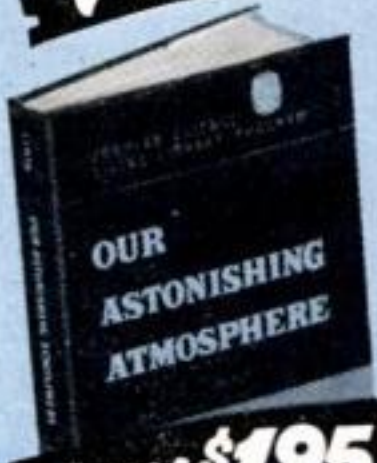
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